[illegible] FEBRUARY, 19[illegible]

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

CANNING

NUMINIK

SUBMERGED PLATING BARREL

Easily Unloaded

- FOR SOLUTIONS OTHER THAN CHROME
- CAPACITY 3 GALLONS OF ARTICLES
- IDEAL FOR USE IN CONFINED SPACE WITH LOW HEADROOM
- SIMPLE TO OPERATE
- THE LOADED BARREL IS SO BALANCED THAT IT CAN BE RAISED AND UNLOADED WITH THE MINIMUM OF EFFORT
- PLATED ARTICLES DISCHARGED THROUGH A CHUTE INTO A BASKET

No Hoist required

Rapidity of loading and unloading with little operator fatigue is an outstanding feature of this barrel.

W. CANNING & CO. LTD. BIRMINGHAM · LONDON · SHEFFIELD

ANTIMONY

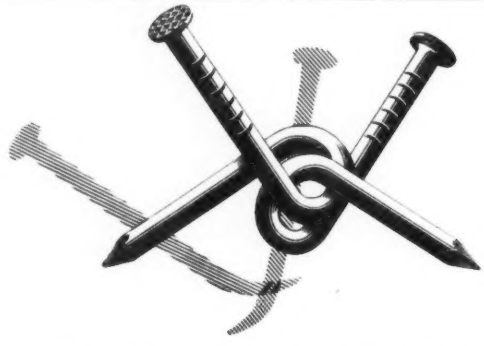
ST. HELENS SMELTING COMPANY LIMITED

RAVENHEAD WORKS

ST. HELENS · · LANCASHIRE

THE RAVEN HEAD BRAND

Telephone: St. Helens 2217/8 *Telegrams: HELENA St. Helens*



PUZZLED

if you have a difficult design problem and an even more difficult production problem then

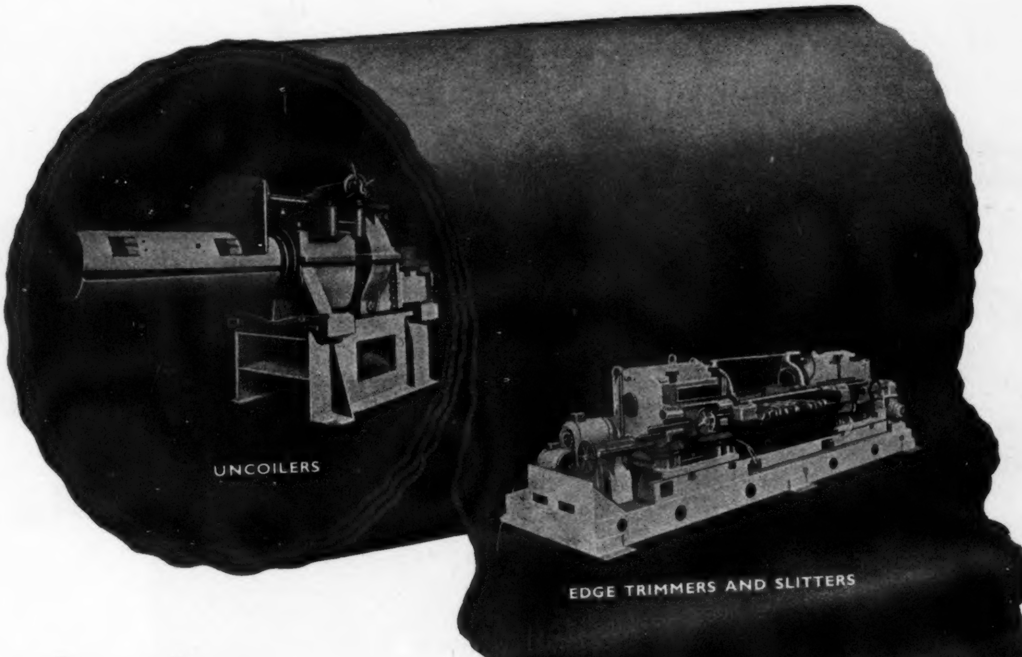
call in our specialist staff. They have an uncanny knack of solving the most difficult problems in the design and production of complete units demanding specialists' experience in sheet metal fabrication and assembly.

Specialists in design and complete unit production.

Camelinat

Member of the Owen Organisation

E. CAMELINAT & CO. LTD.,
CARVER STREET, BIRMINGHAM, 1
Phone: CENtral 6755 (5 lines)
Grams: Camelinat, B'ham.



shaping up to requirements

These machines are examples from the extensive range of equipment built by The Head Wrightson Machine Company for steel and non-ferrous metal production and fabrication. In these fields, Head Wrightson machines are effecting significant economies and increased production. Our engineering and manufacturing resources are always available to deal with your special requirements.

THE HEAD WRIGHTSON MACHINE CO LTD

COMMERCIAL STREET · MIDDLESBROUGH

LONDON · JOHANNESBURG · TORONTO · SYDNEY · CALCUTTA

P.2000


SIR JAMES FARMER NORTON & Co. LTD

Electrical Aids in Industry — *Data Sheet* **No. 8**

Light-Sensitive Cells

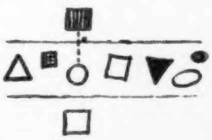
What are light-sensitive cells? They are devices which can sense and measure changes in the level of light or, in some cases, respond to the quality of light falling on them. There are various types of cell and each has its particular field of use. One of the best known is the photo-electric cell.

What can light-sensitive cells do? A change in the amount of light falling on the cell can cause a switch, relay or counter to operate. Alternatively, the direct indication of the light intensity can often allow some other factor to be determined and, if required, controlled. They are reliable and require little maintenance. Careful installation, as with all types of equipment, gives a good reward.

How can they be used? These cells have many applications in industry, for controlling processes, for inspection and measurement, for sorting material and for safety purposes:

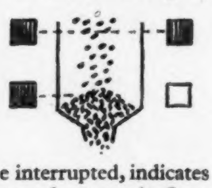
Counting

Where objects on a conveyor belt are too soft or light to operate a direct mechanical counting device, where they are too delicate or freshly painted to sustain physical contact or where the articles vary in size, a light-sensitive cell can be used. This counts the objects by interruption of an appropriately sited beam of light.



Hopper or Tank Level Control

Many forms of feed can be accurately controlled by light cells. One important one is for controlling the input to a hopper of fluid solids such as sand or peas. Here, two horizontal light beams are required: the upper, when interrupted, indicates that the hopper is full and stops the supply; the lower, when it ceases to be interrupted, indicates that the hopper is nearly empty and restarts the flow.

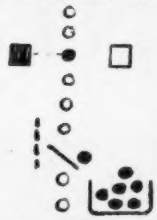


Package Content

The level of powder in packages can be checked with light cells. The cell is so positioned that when the powder is up to the required level, the light reflected from the surface of the powder is picked up by the cell and causes the carton to be accepted. If not, it is rejected.

Colour Sorting

The quality of many articles can be gauged by their colour—seeds and nut kernels, for instance. The objects are fed into a tube by means of a vibrator pan and fall into the beams of three equally spaced light cells which scan them from all sides. If the object is acceptable it falls into a chute carrying it to one conveyor; if its colour is bad it is deflected as a reject.

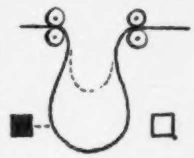


Guillotine Guard

Light cells for guarding a guillotine or power press should be used only as a supplement to a mechanical guard or where the latter is impracticable. The interruption of a curtain of light by a hand stops the machine instantaneously.

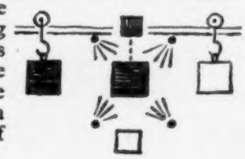
Press Feeding

Where the rate of feed of strip metal must be suited to a varying speed of acceptance by a press, a loop of the strip is allowed to sag between the feed and the press. When the loop reaches a predetermined depth a light beam is interrupted and the slack is taken up.



Processing Objects on the Move

Many articles are processed while on a conveyor line. For instance, where articles are to be sprayed while on the conveyor, the paint saved by stopping the gun between articles will make the device worthwhile. The same principle applies in a bakery to the spraying of baking tins with fat.



Automatic Door Opening and Closing

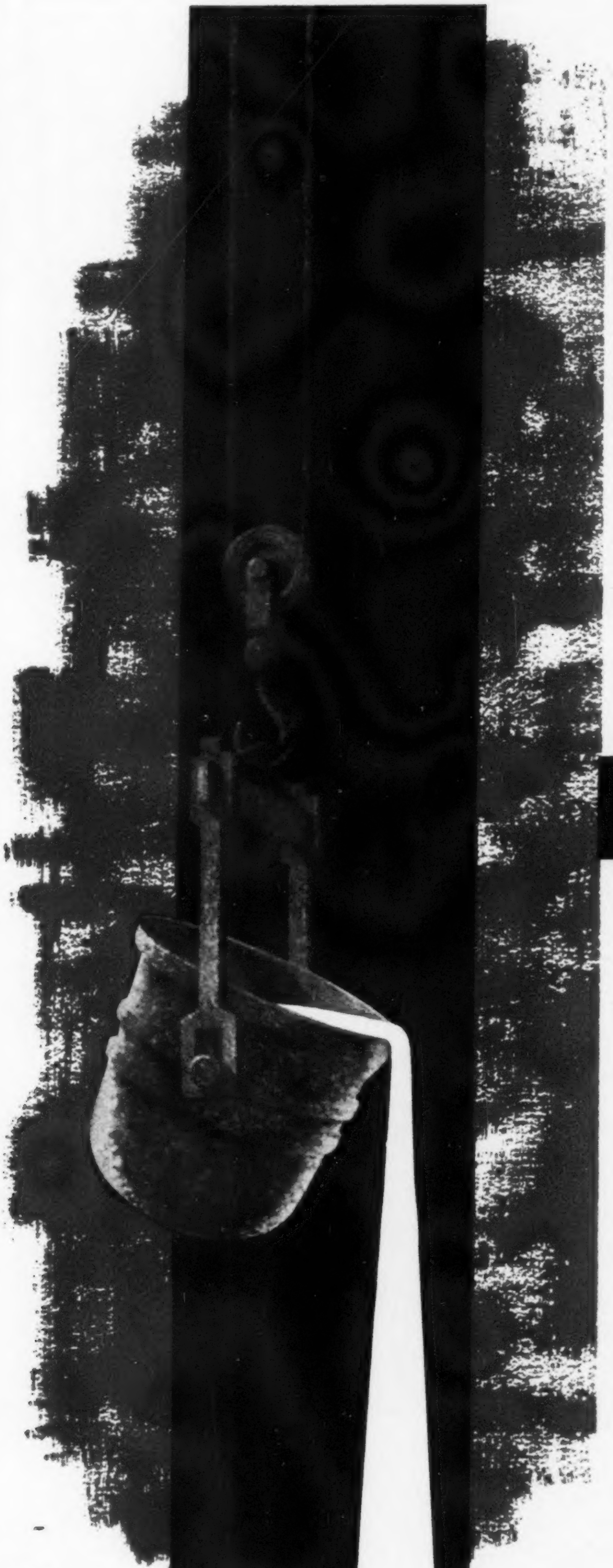
Doors can be caused to open or close by the interruption of a beam of light. This has its uses in such cases as control of doors on a heating oven or for the passage of vehicles in a factory. This is effected by a light beam on the side from which the approach is made (in many cases, both). When the approach beam is interrupted it opens the door which closes again after a given time interval.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association.

An excellent series of reference books are available (8/6 or 9/- post free) on electricity and productivity — "Higher Productivity" is an example. E.D.A. also have available on free loan a series of films on the industrial uses of electricity. Ask for a catalogue.

Issued by the Electrical Development Association
2 Savoy Hill, London, W.C.2

CUT HERE



And . . . why not!

Frankly the purpose of this advertisement is to bring to your notice that our prices for non-ferrous ingots of the highest quality may well be a good deal cheaper than those you are already paying—and our deliveries are exceptionally good, too. Then why the setter with philosophical doubts? Well, we thought that at first sight you might be rather more interested in her than in us. But now we have come this far together, may we send you particulars of our production facilities and details of our very keen prices?

Platt METALS LTD

GOLD MEDAL BRUSSELS WORLD EXHIBITION 1958 THE ENGINEERING CENTRE COLLECTIVE EXHIBIT.

PLATT METALS LIMITED · ENFIELD · MIDDLESEX · HOWARD 3351*

# METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

13 FEBRUARY 1959 VOLUME 94 NUMBER 7

CONTENTS

PUBLISHED EVERY FRIDAY BY ILIFFE & SONS LIMITED

Editorial Offices: 9 Charlotte Street, Birmingham 3 . Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. 'Grams: "Metustry, Sedist, London"

Branch Offices: MANCHESTER: 260 DEANSGATE, 3; telephone, Blackfriars 4412 and Deansgate 3595. BIRMINGHAM: KING EDWARD HOUSE, NEW STREET, 2; telephone, Midland 7191. COVENTRY: 8-10 CORPORATION STREET; telephone, Coventry 25210. GLASGOW: 26a RENFIELD STREET, C2; telephone, Central 1265

ANNUAL SUBSCRIPTION

HOME £3 7s. 6d. OVERSEAS £3 12s. 0d. CANADA AND U.S.A. $10.00

INCLUDING ONE COPY OF **METAL INDUSTRY HANDBOOK,** *PUBLISHED ANNUALLY*

METAL INDUSTRY

VOLUME 94 NUMBER 7 13 FEBRUARY 1959

Research and Development

EVEN in times of recession most progressive companies realize that it does not pay to cut back on research expenditure. Without this fundamental appreciation of the value of research, very little of the enormous sums now made available for its financing would be forthcoming. Even as it is, voices are forever being raised to claim that these sums are not enough, and every effort is made to publicize the aims, objects, methods and achievements of research so that its value may be more and more appreciated. Not a single rocket blasts off into outer space but that a proper appreciation of the situation is fostered by appropriate public relations activities, with references ranging from expanding knowledge, through space travel and better weather forecasting, to the inter-continental transmission of TV commercials. In their own more modest ways, there can be few industrial research laboratories that do not take the trouble to keep the powers-that-be informed in simple language of what is going on in the laboratory, and what the results of these activities may confidently be expected to be.

Things being as they are, it is only natural that there should be at least two ways of looking at research activities. The first, and most obvious, is: what do we get out of them in terms of hard cash? This point of view regards research and development as competitive activities in the same sense that manufacturing and selling are competitive; the only radical difference being that the stakes in research are much greater and more difficult to measure. Indeed, a yardstick capable of measuring the productive effect of research and development programmes simply does not exist. How can it be otherwise when the commercial results of the work of an efficient research and development staff may not be known till five years after the work was completed?

If commercial results be the sole criterion for supporting research, it can be amply justified by the fact that technical improvements are coming so rapidly that many companies now derive the major portion of their sales revenue from products that did not exist ten years ago. From this point of view, the object of new product development is to achieve a rate of growth faster than that of competitors or that of the market being served. One of the best methods of attaining this end is by the closest co-operation between the manufacturer and any consumer who has a problem. The latter, by stating his problem in a concise manner and by providing a thorough evaluation of new products furnished by the supplier, can not only help himself but also be of great assistance to the manufacturer.

But, what of the other view of research activities? Unfortunately, it seems that in spite of the lip service being paid in many quarters to pure research, times are such that no research, the monetary value of which is not at once apparent, or at least which cannot be made to appear of cash value in a reasonably plausible manner, stands much chance of being undertaken. Any appearance to the contrary is discounted by the fact that, so deeply ingrained is the feeling that research must be a paying proposition, only research projects having this promise are being picked for consideration. Is it too much to hope that, bearing in mind the likely consequences of this unfortunate state of affairs, the value of undertaking valueless research will, in due course, come to be appreciated?

Out of the
MELTING POT

Applied Imagination

FOR better or for worse—probably the former — writers of science fiction incline to leave the more mundane fields of science and technology severely alone. What, for example, could a science fiction writer make of the casting process and of the average foundry, fields that are still left to the more prosaic practical inventors, some of whom exercise as much imagination—and to better purpose withal—than your average science fiction writer? Take, for example, the rigid three-dimensional surfaces of casting moulds. Not much scope for the imagination, you might think, yet consider whether it might sometimes be possible to dispense with some or all of them, and what the possible advantages of such a course would be. Dispensing with one dimension, one obtains an open-ended mould, variants of which make possible the various processes of continuous casting. Alternatively, if it is desired to keep the cast metal in place with only two dimensions at one's disposal, the additional reaction required can be introduced by rotating the mould as in the centrifugal casting of pipes. The next step on the way towards dispensing with the casting mould is rather more difficult. One possible solution recently suggested consists in making use of what might be described as a "virtual" mould. The "surface" or "surfaces" of such a mould are formed by moving one or more bodies along a closed path during casting in such a manner that the inner or outer envelope of the individual positions of the bodies constitutes the surface of the casting mould. The speed of movement of the bodies is made such that they pass over individual portions of the casting in such a sequence, and at sufficiently short intervals of time, that outward movement of the cast metal in the time between the passages of the body or bodies is limited to an amount which can be pushed back by the following body. Finally, there remains the possibility of casting without the use of any mould whatsoever. Need such mouldless casting be restricted to the production of shot?

Too Fast ?

AN examination of the consequences and the cost of the pursuit of novelty might well be added to the list of such projects as research on research, on the expenditure on research, on the availability of scientific and technical manpower, etc. Can some of the results and conclusions be anticipated? In regard to cost, whether an estimate would prove possible or not, the conclusion would have to be that the cost is being met, and that it could continue to be met if desired. The consequences of the pursuit of novelty might be easier to determine. One of them becomes apparent whenever an attempt is made to trace the course of any such pursuit. Take, for example, shell moulding, electrolytic tinplate, titanium alloys, the surface treatment of magnesium, or any other subject the development of which has been pursued fairly rapidly. Tracing this development back, one notices only too soon the dreadful state of untidiness in which the records of the development have been left; one might almost say dropped. In all of them the haste to get on is only too apparent, while the need for continuity and coherence, where some attempt has been made to meet it, has clearly been given minor consideration. The results are such that, faced with a comprehensive survey of them, one cannot help but start wondering how the particular subject could have possibly reached its present position and state if that was really the course of its development. Indeed, one is likely to be left harbouring the suspicion that the excellence of its present state of development is more apparent than real. If what one is faced with is all there had been to say about it in the very recent past, can there be much more to say about it at present? Would it be true to claim that the condition of any particular development is no better than the literature relating to it? If so, both of them in very many cases are nothing but deplorable; just one of the consequences of the over-rapid pursuit of novelty.

Hurried

IN most conventional fatigue testing machines, mechanical factors set a limit to the extent to which the stress cycle can be speeded up. By replacing the mechanical systems by an electromagnetic arrangement for developing cyclic loads to be applied to test-pieces, machines have been built in which tension-compression fatigue tests can be made at speeds as high as 5,000 cycles/sec. An upper limit to this method is set by the characteristics of available magnetic materials. By abandoning the electromagnetic system, and adopting instead a piezoelectric system of excitation, the French investigators, F. Girard and G. Vidal, have developed a set-up in which small test-pieces can be fatigue tested in tension-compression at rates of the order of 90,000 cycles/sec. In this arrangement, the length of the test-piece must be calculated to ensure that the frequency of vibration of the test-piece is equal to that of the piezoelectric (barium titanate) transducer. For frequencies of the order of 90,000, the length of the test-piece is about 30 mm. The test-piece diameter (2-3 mm.) is not critical. In order to achieve the necessary stress amplification, the vibrations from the transducer are applied to the test-piece through a mounting positioned just off the nodal point at the middle of the test-piece. On both sides of the mounting point, the test-piece diameter is reduced to form gauge lengths, both the ends of the test-piece being free. In addition to the piezoelectric transducer and the mounted test-piece, the set-up includes a microphonic pick-up located near one end of the test-piece and intended to pick up the vibrations induced in the test-piece. The output from this pick-up is used to ensure that the frequency of the generator is always "tuned" to the natural frequency of the test-piece. Finally, a microscope, focused on the brightly illuminated end of the test-piece, is used for direct measurement of the maximum strain. The arrangement described has been used for tests on Duralumin, which were continued for up to three thousand million reversals (test-piece fractured under a stress of 14·7 kg/mm^2) without a definite Wöhler type fatigue limit being reached. The advantage of the method will be apparent from the fact that three thousand million stress reversals take only 8 hr. It must be pointed out, however, that fatigue fractures could not be obtained using the above method with some materials having high damping capacities.

Skimmer

MOLYBDENUM — NIOBIUM — TANTALUM — RHENIUM — TUNGSTEN

Fabrication of Refractory Metals

By W. L. BRUCKART

(Concluded from Metal Industry, *6 February* 1959)

TUNGSTEN has the highest melting temperature of any of the metals under review, as indicated in Table I. It is approximately twice as dense as molybdenum, and possesses somewhat greater stiffness than molybdenum. Although harder than molybdenum, tungsten cannot be classified as a hard metal. Like molybdenum, tungsten can be heated rapidly, and will also cool rapidly. Its expansion characteristic is approximately three times that of molybdenum.

Although tungsten appears very much like steel, or molybdenum, its extreme heaviness will generally provide identification, and prevent mistaking tungsten for some other material during fabrication.

Alloys of tungsten are not generally known in commerce, and the only variation from pure tungsten contains a small quantity of thorium oxide for grain size control in fine filament wire.

Uses of tungsten have been restricted in the past to those applications which could best be met by small-sized products of limited workability. Until tungsten becomes available in the same manner as molybdenum, and until its fabrication can be accomplished with reasonable facility, its use pattern will be very slow to change.

Tungsten can be formed in a limited way, and in every case forming must be done hot. Fig. 27 is presented as a very tentatively suggested minimum working temperature relationship for various thicknesses of tungsten sheet and bar. It must be constantly remembered that tungsten is a brittle material at room temperature.

Practically all bending and twisting of tungsten is limited to wire less than 0·020 in. diameter. Owing to the limited ductility, even hot, not much work should be attempted on tungsten.

Very little experience has been gained in spinning tungsten. Very light gauges, 0·020 in. and lighter, have been spun in small diameters, 1 in. or less. Since spinning is similar to bending, the same precautions must apply.

No data are available on the fabrication of tungsten by floturning.

It is not recommended that hydroforming and deep drawing operations be performed on tungsten.

Tungsten should not be sawn by techniques other than cut-off wheels. Thin-bonded silicon carbide wheels which are water-cooled can be used successfully to cut tungsten rod at a peripheral wheel speed of about 12 to 15 ft/sec.

Shearing can be done if the sheet and tools are heated. A highly-alloyed high temperature steel or hard metal should be used as the shear knife, particularly in the case of sheet heavier than 0·040 in. thickness.

No data are available on the practice of slitting tungsten, but it must be inferred that this operation should be limited to the same practice as shearing.

The same precautions apply to punching and stamping as to shearing, except that heavy sheet (0·040 in. and heavier) must be stamped with warm tools.

Machining of tungsten is very difficult. It has been recommended that only hard metal tools of grade H2 should be used for lathe turning, planing, milling, and boring. The tool should have a top rake of 20° to 25° and a clearance of 5° to 8°. Cutting may be accomplished under the following conditions: speed, 6-10 ft/min.; feed, approximately 0·005 in.; depth of cut, 0·02 to 0·04 in.

Threads are not cut on tungsten commercially, except by grinding.

The same precautions apply to drilling as for lathe turning, etc.

Much of the fabrication of tungsten pieces is accomplished by grinding. Silicon carbide wheels with a grain size of 100 to 120 mesh can be used. Grinding wheel speed should be 10 to 15 ft/sec. under continuous water-cooling.

Tungsten cannot be folded or riveted, but in some cases bar stock can be upset warm to a degree sufficient to lock the bar stock in place at a joint.

Tungsten may be brazed in the same manner as molybdenum, and with the same brazing alloys. Since its recrystallization temperature is approximately 100°C. higher than molybdenum, a wider choice of brazing materials is available.

Welding is possible with tungsten, and in some electronics applications it is accomplished, provided no further deformation is intended for the objects that are welded. Resistance welding and Heliarc welding are used. Published data are not readily available.

Stress relief annealing of tungsten can be accomplished at approximately 980°C. for periods up to 1½ hr.

Recrystallization of tungsten is undesirable, in that it severely limits an already brittle material, and it is not recommended.

Tungsten may be cleaned in the same manner as molybdenum.

Tantalum

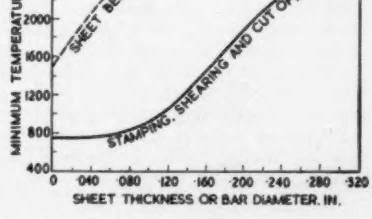
Tantalum is a very unusual, easily-worked metal. It is midway between tungsten and molybdenum in density, and also in melting point. If it were not for the greater density of tantalum, its very much higher cost, and in some cases its lower stiffness compared to molybdenum, tantalum would undoubtedly be used in much greater quantities than it is to-day. In some respects tantalum has advantages over molybdenum in that it has a heat conductivity of approximately one-fourth that of molybdenum, and an expansion coefficient approximately one-third greater than molybdenum. Reference to Table I will reveal the comparative properties of tantalum and the other refractory metals.

There are no commercial tantalum-base alloys to-day. Tantalum alloys containing tungsten in sizeable concentration, and possibly containing other elements in lesser concentration may some day be useful in the high temperature metals applications.

One unusual application of tantalum is its use in bone surgery. This use results from its unusual corrosion resistance, and the absence of toxicity in tantalum compounds in the human system. Tantalum is known for outstanding corrosion resistance. Except for hot concentrated sulphuric acid, and liquids containing high concentrations of sulphuric acid, and solutions or environments which alternate between acid and alkaline

Fig. 27—Suggested minimum working temperatures for tungsten shapes

Stretch-forming, deep drawing or hydroforming are not recommended. Hand sawing is not practicable. Spinning and floturning are limited to small deformations.



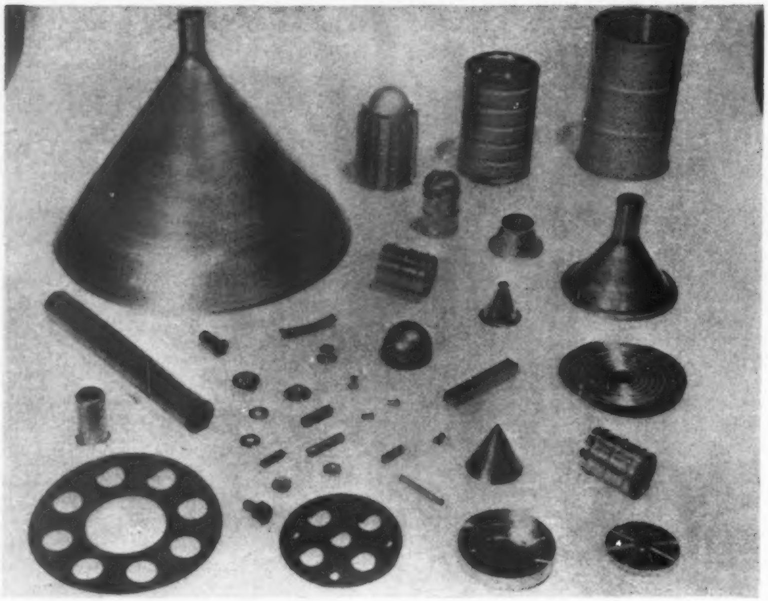


Fig. 28—Fabricated tantalum parts [Courtesy Fansteel Metallurgical Corporation

conditions, tantalum is practically corrosion-resistant to any commercial combination of acids. It does not generally resist alkalis. For this reason, coupled with its excellent fabricability, tantalum can be used in practically all chemical engineering equipment.

Forming operations — bending and twisting, spinning and floturning (hydrospinning)—are most readily conducted on tantalum at room temperature, and in some cases the use of a soapy type of lubricant is advantageous. Heavy sections of tantalum may be more readily formed by gentle heating, but it is important to limit heating to a maximum of 260°C.

Hydroforming and deep drawing operations can be conducted with relative ease at room temperature with about the same technique as for copper or aluminium. Deep drawing can be accomplished on annealed sheet, in many cases in one operation. The depth of the draw in such a case can be equal to the diameter of the blank. If more than one drawing operation is required, the draw depth should not be greater than 40 to 50 per cent of the diameter of the blank. A suitable lubricant for operations of this type is sulphonated tallow. Examples of some tantalum parts to which some or all of these operations have been applied are shown in Fig. 28.

Sawing of tantalum is not quite so easy as the forming operation. Owing to the extreme ductility of this material, it tends to flow with the saw blade and to "gum up." Consequently, the proper equipment and conditions must be set up prior to this operation. The use of chlorinated solvent as lubricant and cooling agent will materially aid sawing success.

The shearing of tantalum is conducted with ease provided the tools are sharp. No special precautions need be taken otherwise.

For slitting of tantalum, the same precautions will apply as for shearing.

Annealed tantalum can be stamped and formed in dies without any springback. Steel dies are quite satisfactory for this operation. The clearance between punch and die is critical, and should be approximately 6 per cent of the thickness of the sheet. An application of light oil or carbon tetrachloride, as in the case of roll threading or machining, will prevent the scoring of the dies. Since it becomes work-hardened at a very slow rate compared with most other metals, reductions of great amounts may be taken without intermediate anneals. In the manufacture of tantalum sheet and bar, it is often the practice to take reductions in excess of 90 per cent (of cross-section area) without stopping to stress relieve or anneal the material.

Tantalum can be machined without particular difficulty provided its tendency to gall and tear is recognized. The use of carbon tetrachloride or a light oil will materially assist in the prevention of galling. Tools with angles similar to those used for annealed copper are satisfactory. A minimum surface speed of 100 ft/min. should be employed in turning tantalum, because slower speeds cause tearing of the metal. When using carbon tetrachloride as the machining lubricant, the work must be flooded at all times.

A general rule to be followed in all machining operations requires the use of a number of light feeds and very sharp tools. It is best to complete the machining operation with each cut, rather than to take roughing cuts followed by light finishing cuts. Roughing cuts followed by light finishing cuts do not result in a satisfactory finish, owing to the tendency for tantalum to gall and flow over the succeeding cuts.

Screw threads may be cut in tantalum by normal machining or grinding techniques, following the necessary precautions. However, it is quite easy to roll-thread owing to its extreme ductility. This is a very satisfactory method of establishing threads in tantalum.

Standard high speed drills may be used for drilling operations, but since it tends to gall, extra care must be taken to ensure thorough lubrication. Drilling should be approximately 30-40 ft/min.

Grinding is accomplished in tantalum with the same precautions as would apply to machining in general. Since tantalum tends to flow rather than to chip, it is quite likely to load any abrasive wheel used for grinding. Using the proper techniques, tantalum may be ground or polished quite satisfactorily to a very high lustre.

Owing to the extreme ductility of tantalum, mechanical joints are readily accomplished by all common techniques. Tantalum rivets are available, and will upset quite satisfactorily to make tight joints.

Brazing can be accomplished by the use of special brazing techniques. One very important precaution to observe in the brazing of tantalum is that all gases which have any reactivity must be excluded. This, therefore, means not only oxygen, but carbon monoxide, ammonia, hydrogen, nitrogen, and, in some instances, carbon dioxide. Tantalum readily forms carbides, nitrides, oxides, and hydrides, and alloys with some of these gases. The surfaces must be electroplated with copper or nickel, and diffusion treated at about 1,260°C. prior to brazing. Standard brazing alloys may then be used, and brazing may be done in air, provided the basic metal is not overheated. It is preferable to conduct brazing in some inert gas-shielded area, such as a dry box. Lacking this, generous gas flow around the brazed area is helpful.

All welding, whether of tantalum to tantalum or to other metals, must be in the absence of any reactive gas, as was mentioned under brazing. Helium or argon inert-gas arc welding processes are satisfactory. Spot and seam welding can be accomplished on tantalum, conducted usually under water so as to avoid any excess of air to the heated parts adjacent to the welds. Spot welding in air is quite satisfactory if the timing is held to one cycle. The metal cannot be torch welded.

One point to remember in the pressure welding of tantalum is to avoid use of too much pressure. If very heavy pressure is used, the contact between the two tantalum pieces is so good that very little resistance is developed and no weld is obtained.

Tantalum is one material which can be annealed to produce improved room

temperature ductility and formability. It requires a good vacuum environment in order to prevent contamination, such as was outlined in the brazing and welding sections. Any temperature above 1,070°C. will satisfactorily recrystallize tantalum. It is unwise to attempt to anneal tantalum unless proper equipment is available.

Cleaning may be carried out by conventional methods, except that hot caustic solutions should not be used since they attack the metal. The use of hot chromic acid cleaning solution (glass cleaning solution) also is quite satisfactory. Shot blasting, followed by hot hydrochloric acid (to dissolve the iron particles) will also assist in making the glass cleaning solution more effective.

As with other metals, abrasion and normal machine shop surface removal techniques are applicable provided the galling tendency of tantalum is kept in mind.

Niobium

Niobium is very similar to tantalum. The two metals occur quite frequently in ore form together. Of all of the refractory metals, niobium has the lowest melting temperature, the lowest modulus, the lowest heat conductivity, and is mid-range in thermal expansivity. It has little strength, and is also the lightest of the refractory metals. A comparison of its properties with the other refractory metals can be obtained by reference to Table I.

No commercial niobium-base alloys exist, although a very intense alloy development programme is under way, and commercial alloys in this material should be known within the next 12 to 15 months. All of these alloys being developed are based on the use of arc melting techniques for consolidation of the niobium and its alloys. Alloy development is aimed at producing high strength oxidation-resistant material for use above 1,100°C.

Since it is not quite so readily available as tantalum, and does not possess so outstanding a combination of properties, the use pattern for niobium is far more restricted than for tantalum. Most of the potential uses are under development, and many of them will require niobium-base alloys which are as yet experimental.

Niobium can be bent and twisted with the greatest of ease, as with tantalum, copper, and aluminium.

It may be readily spun at room temperature, using a soapy type of lubricant. In heavy sections (⅛ in. or greater) some heat may be applied provided the temperature at the hottest region does not exceed 200°C. to 260°C.

Similar precautions apply to floturning as to spinning. Hydroforming and deep drawing operations are readily conducted on niobium, and are aided by the use of a chlorinated solvent for lubrication.

The same precautions apply to niobium as to tantalum. Use a lubricant and saw in a manner to avoid galling.

Shearing and slitting are readily accomplished at room temperature on almost all sections of niobium sheet or bar. The same requirements apply as to tantalum.

For punching and stamping, the same precautions apply to niobium as to tantalum.

In lathe turning, planing, milling and boring, niobium can be machined with high-speed tools if light cuts are taken and a suitable chlorinated solvent is used for lubricant. A suggestion has been made to consider Tantaroll II[1], which is a proprietary compound that can be brushed or sprayed on to the tool and the workpiece. In machining niobium, the cutting speed should be between 50 and 60 ft/min, with a feed rate never greater than 0·12 in/rev. and 0·060 in. depth of cut maximum. Tool point angles recommended are: approach angle 30°, side clearance 5°, side rake 5°, trailing angle 45°, back rake 10°, nose radius 0·020 in.

Screw threads may be cut in niobium as in tantalum; however, roll threading is quite satisfactorily accomplished on the annealed bar. If threads are cut, ample lubricant of the chlorinated hydrocarbon type must be used. Stock should be 0·005 in. undersize and the tool should be fed so that it cuts on one side of the thread angle only.

Standard high-speed drills may be used for drilling, but since the parts wear so fast in this operation, care must be taken to see that the drill does not become undersize without notice. Drilling speed should be 30 to 40 ft/min.

For grinding, punching and stamping the same precautions apply to niobium as to tantalum.

Owing to the extreme ductility of this material, mechanical joints can be formed with the same degree of ease and diversification as in tantalum.

When niobium (or tantalum) is brazed, one satisfactory technique to avoid contamination of the joint is to copper plate or nickel plate the metal. The deposit then can be bonded by diffusion at about 1,260°C. in vacuum. This surface can then be readily brazed to another metal without contaminating the niobium. Standard brazing techniques then apply. Inert gases must be used as shields.

Welding of niobium is conducted in the same manner as the welding of tantalum. Very ductile welds are obtained using Heliarc techniques with high purity Grade A helium that has been passed through a dry-ice freeze-out coil. Welding may be conducted either in chamber or in air. One set of data provided from the welding of niobium with a "Heliweld" automatic head is given in Table V.

It is necessary that niobium be extremely well cleaned on the surface so that any oxide or contamination lodging there will be removed, and not melted and mixed into the weld zone. Welding of niobium has been described as being similar to that of welding titanium. It is by no means as difficult as the welding of molybdenum and its alloys.

The same precautions and temperatures apply to the annealing of niobium as to tantalum.

The same techniques for cleaning tantalum will apply to the cleaning of niobium. One method of cleaning in preparation for welding uses hydrofluoric-nitric acid solution.

Rhenium

Rhenium metal is quite new as a material of construction. A review of Table I shows that it is next to tungsten in high melting temperatures, is heavier than tungsten, and stiffer than any of the other refractory metals. Although thermal conductivity data are not available, its use in electronic applications would infer a reasonably high thermal conductivity. This metal is generally cold workable, and work-hardens to an extreme degree with very little work. Some laboratory information has been developed to show that rhenium will develop two to three times the hardness of the fully-annealed metal with reductions in cross-section area of 40 per cent or less. This property of rhenium requires that it be annealed frequently if much deformation is to be given to the material during fabrication. Unlike tungsten, rhenium is quite ductile in the fully annealed state.

No commercial alloys are available with rhenium as the base. Considerable development work has been done to show that alloys containing approximately 35 per cent rhenium, with the balance either tungsten or molybdenum, create cold workability and cold ductility in tungsten or molybdenum to a very much greater degree than any other addition. A number of combinations of rhenium-base alloys are being studied, and it is expected that useful compositions will be known within the next year.

Since rhenium is barely emerging from the laboratory curiosity stage, its uses thus far are dependent upon electronic applications similar to those met with tungsten, and for use of rhenium as one part of extreme high temperature thermocouples. These uses employ rhenium as wire or strip. They also take advantage of rhenium's resistance to extreme mechanical shock after service at very high temperatures, and its ability to be deformed in the annealed state.

Few published data are available on the forming of rhenium, but practice should be conducted with the reminder that rhenium work-hardens very rapidly, is ductile in the annealed state, and, therefore, should lend itself to all manner of forming operations if proper care is used.

Rhenium can be joined to other metals by brazing techniques, and by

(*Continued on page* 132)

Readers' Digest

METAL PHYSICS

"The Physics of Metals and Metallography." *Vol.* 4, *No.* 1, 1957. *Published by Pergamon Press*, 4-5 *Fitzroy Square, London, W.*1. *Pp.* 159. *Annual Subscription* (2 *vol.*) £10 14*s.* 0*d.*

THE volume under review is but one number of a scientific journal, issued bi-annually, and must, therefore, be regarded as a random sample. The existence of such a periodical may not be widely known, and it is appropriate to mention that it is being published by the Pergamon Press for the Pergamon Institute, and is a translation of the Russian journal Fizika Metallov i Metallovedene. The necessary financial support is provided by the National Science Foundation and the U.S. Atomic Energy Commission. The standard of production of the translated edition is high, and this is achieved by arrangement with the U.S.S.R. Academy of Sciences, which provides "rush" copies and original illustrations on loan. As an example of international scientific co-operation, the project deserves to be widely known.

The issue under review contains 26 Papers and 9 letters in 159 pages. The subjects dealt with range from the mathematical physics of the solid state (e.g. "the multi-electronic theory of semiconductors") to more technical topics, such as the texture in low carbon steel after cold rolling. A wide spectrum of metallurgical research is covered, including the study of cermets and the oxidation of iron. As far as can be judged, the work described is of high quality, and there appears to be little difference between the types of problem which the Russians are studying and those which engage the attention of their Western colleagues. This makes it all the more important that Russians and the West should keep in contact over their scientific work, and the exchange of information by means of translations such as that under review is certainly to be encouraged.

Consideration of the places of origin of the 26 Papers in this particular issue shows that no fewer than 10 were submitted from the Institute of Physics of Metals, Urals Branch, Academy of Sciences of the U.S.S.R. This Institute, to judge from the breadth of its interests, is in a flourishing state, and a knowledge of its output would appear to be very necessary for metal scientists in this country.

On the whole, the panel of translators, without whom no publication of this sort would be possible, have done excellently, though the translation is not always felicitous. Occasional ambiguities arise, and sometimes the translator has had to add a note about his difficulties with certain symbols. In some cases, also, reference to the original Russian Paper is necessary, as, for instance, where a translator has provided the headings of a table but has referred the reader to the original for the actual figures.

Although the existence of yet another journal to be studied may not greatly please the conscientious literature-searcher, "The Physics of Metals and Metallography" must certainly figure on his list of journals to be consulted.

G. V. R.

PLATING BATHS

"Analysis of Electro-Plating and Related Solutions." *By K. E. Langford. Published by R. Draper Ltd., Kerbihan House*, 85 *Udney Park Road, Teddington, Middlesex. Pp.* xv+423. *Price* 60*s.* 0*d.*

A SECOND edition of this well-known work will be certainly greeted with enthusiasm by everyone concerned with the analysis of plating solutions and all who have found the first edition such a valuable addition to the literature of the industry. It is true to say that the work provides a really authoritative text book on analysis, a field covered by no other single work.

In this edition, the author has revised and expanded the text to include new methods, but it is gratifying to see that he has adhered to his original scheme of providing, where possible, alternative methods for each estimation, and classified them as to their suitability for use by plater or chemist.

A particularly fine feature is the explanatory notes for each method, giving the significance of each step and the theory behind each method.

In this new edition, the author has included many new methods employing E.D.T.A. that are rapidly being adopted as replacements for existing time-consuming established techniques. It may be considered by some, perhaps, that even with the considerable space devoted to these new techniques, the author has been a little on the cautious side in his application of E.D.T.A. methods for plating analysis. However, in his insistence on recommending only methods of tried and proved value he has maintained the high standards which are associated with this work, so that any analysis method recommended may be used with the utmost confidence.

It is certain that this edition will be as popular as the first, and it is completely recommended to all whose interest lies in metal finishing.

N. C.

Men and Metals

A new chair of nuclear science and technology has been established at the Royal Naval College, Greenwich, and **Mr. J. Edwards,** recently senior principal scientific officer in the naval section at Harwell, has been appointed to this new chair.

An announcement from British Insulated Callender's Cables Limited is to the effect that **Mr. C. S. F. Lane** has been appointed to the position of Regional Manager for Australia and New Zealand in the overseas organization in London. He succeeds **Mr. R. H. Semple,** who has taken up a senior executive post with an associate company in Australia. Mr. Lane joined the organization in 1932 at the Erith works, where he spent a training period before moving to the contracts department. In 1942 he transferred to the research staff, and after nine years in that department he joined the sales organization.

Following the successful bid for the Telegraph Construction and Maintenance Company by British Insulated Callender's Cables Limited, **Sir John Dean,** chairman of the former company, has been appointed a director of B.I.C.C.

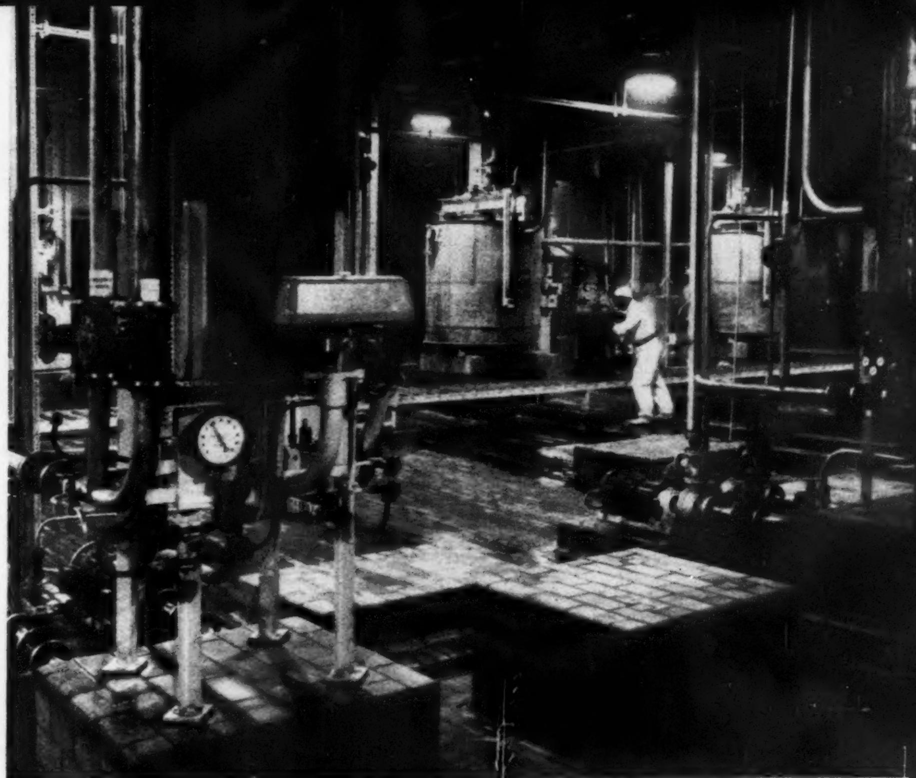
Formerly assistant engineering director of Siemens Edison Swan, **Mr. F. W. H. Shaw** has been appointed deputy managing director of Submarine Cables Ltd. (owned jointly by Siemens Edison Swan and Telegraph Construction and Maintenance).

An announcement from Sir W. H. Bailey and Company Limited is to the effect that **Mr. S. Watts,** chief draughtsman, has been appointed chief engineer (contracts division) and that **Mr. B. Scott-Garrett** has joined the company as chief engineer (control division).

Chairman and managing director of Baird and Tatlock (London) Limited, and of Hopkin and Williams Limited, **Mr. J. E. C. Bailey,** C.B.E., has left for a short tour of Uganda, Kenya, Northern Rhodesia, Southern Rhodesia and South Africa.

Formerly chief engineer of Power Jets (Research and Development), **Mr. James Hodge** has recently been appointed to the newly-created position of chief engineer of the Holman Brothers group.

Appointed a director of Renold Chains, **Mr. C. T. Bayliss** is also on the boards of Bayliss, Wiley and Company Limited and the Perry Chain Company Limited.



Various intermediate stages in the processing of uranium are carried out beneath the deck that carries the primary dissolvers and filters. Here, an operator is shown removing a drum of the insoluble sludge taken from the primary filters. Should sampling indicate that appreciable quantities of uranium are present this uranium will be recovered in the recovery line

Uranium Production

U.K. ATOMIC ENERGY AUTHORITY PROCESSING PLANT AT SPRINGFIELDS

PRODUCTION of atomic energy in Britain at present depends entirely on uranium, and all the source material, in the form of ore or concentrates, is processed at Springfields to produce pure uranium metal for reactor fuel or uranium hexafluoride for the gaseous diffusion plant at Capenhurst. The metal is formed into rods and assembled into fuel elements for the Authority's reactors at Calder Hall and Chapelcross, as well as for the Bepo reactor at Harwell.

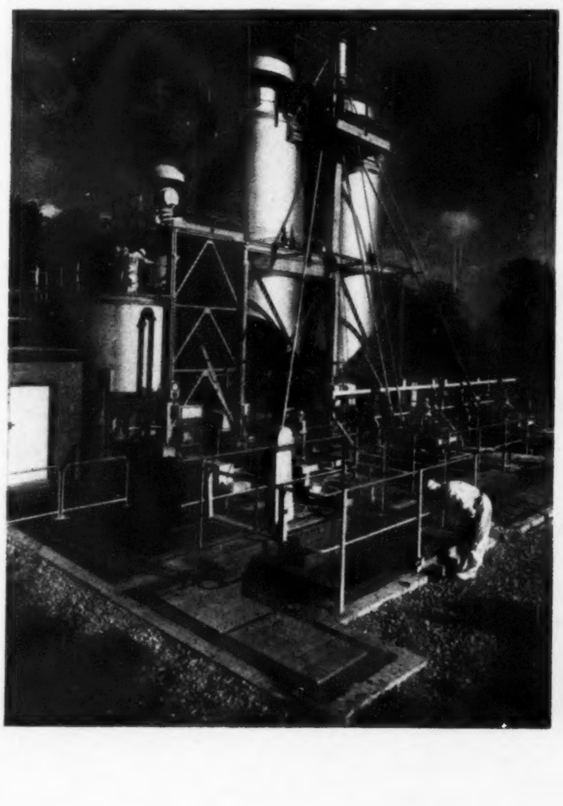
After the fuel elements have been irradiated, they are processed at Windscale to separate the fission products and plutonium from the chemically unchanged uranium. This uranium, in which the proportion of the fissile 235 isotope is reduced, is returned to Springfields as a solution of uranyl nitrate; here, it is converted to uranium hexafluoride for re-enrichment at Capenhurst.

The process now being operated at Springfields is planned to use concentrate, i.e. a crude uranium oxide, as the starting material, thereby eliminating the peroxide precipitation stage of the original process.

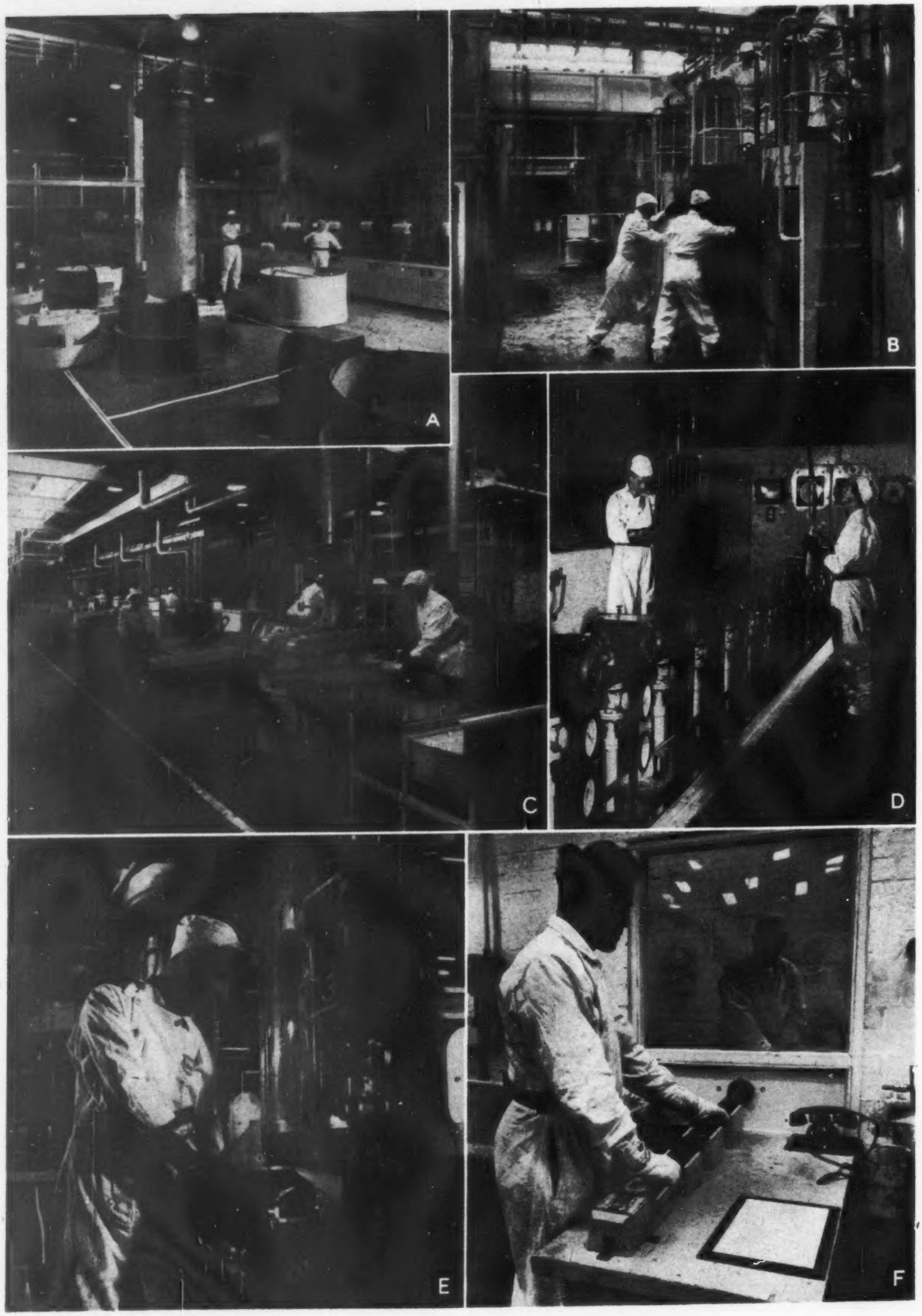
The concentrate is dissolved in nitric acid, in large stainless steel tanks fitted with steam heating coils and stirrers, and the solution, after cooling, is fed to rotary filters.

These filters consist of large rotating horizontal drums of fine mesh, with a vacuum applied to the inside. The lowest part of the drum dips into the slurry from the dissolver, the solution of uranyl nitrate is sucked through the mesh, while the solid impurities are collected on it and then continuously scraped off. These solid scrapings are re-slurried and passed to a second similar filter to ensure that all traces of uranium are removed.

The uranium solution is then purified by solvent extraction with a solution of tributyl phosphate (TBP) in odourless kerosene in mixer-settler units arranged in a cascade. Each unit consists of a mixing section in which the two liquids separate into layers, due to the difference in their densities. Because of its greater solubility in TBP, the uranyl nitrate collects in the solvent phase, leaving the impurities in the aqueous phase. From the settler section, the solvent phase flows "up" the plant to the next mixer section, while the aqueous phase flows "down" to the next mixer section. In this way, the removal of uranyl nitrate from the aqueous phase can be made almost complete. At the top of the plant, the tributyl phosphate emerges containing the uranyl nitrate in solution, passes through a heating unit, and the uranyl



Effluent silos for neutralizing the waste from the main processing plant


A
B
C
D
E
F

nitrate is then washed out of the solvent by a weak nitric acid solution.

The uranyl nitrate solution is treated with ammonia to precipitate the uranium as ammonium diuranate. This compound is then put through the Dryway plant to emerge as uranium tetrafluoride. Ultimately it is planned to carry out this part of the process by fluidized bed methods, and development work is at an advanced stage. The section of the new plant in which this will be done is at present under construction.

The uranium tetrafluoride, and magnesium turnings are delivered to an automatic weighing and mixing machine, which feeds the pelleting press. This also is automatic, and ejects the pellets to a conveyor which delivers them to the reactor breakdown and loading section. (This is a furnace reactor, not a nuclear reactor.)

The reactor consists of a long steel cylinder containing a sectionalized graphite lining. The pellets of UF_4-magnesium are built up inside the lining and the whole assembled into the reactor. The reactor is passed into the adjacent furnace bay, where it is placed in an electric furnace, in which the reducing reaction takes place. After cooling, the reactor is brought back, dismantled, and the slag and uranium billet removed.

The billet goes to the cleaning section, where it is cleaned, sampled and numbered, and sent to store.

Fuel Elements

The first step in the conversion of the uranium metal into a fuel element is to melt the billet in a vacuum furnace, heated by a high frequency induction current, and pour the molten metal into cylindrical moulds. The method used is to pour a complete melt at once by removing a spigot in the base of the furnace; the metal runs into a header which feeds several moulds, the number depending on the length of bar being cast.

After cooling, the mould assembly is dismantled and the rods taken into the bond store, each cast being kept separate.

The rods then undergo a succession of machining operations to bring them to the desired design, with heat-treatments included to produce a satisfactory metallurgical condition to minimize distortion during irradiation. This requires, broadly, a small, randomly oriented grain size. The machining operations are entirely conventional and are carried out on standard lathes or centreless turners, the only special precautions taken being the provision of an exhaust system away from the operator and a copious supply of coolant to prevent ignition of the swarf and minimize the risk of particles escaping into the atmosphere. The turnings are collected, cleaned, and added to subsequent casting charges.

Finally, the rods, inspected, checked for dimensional accuracy and individually numbered, are sent for assembly into fuel elements. There are several reasons why the uranium cannot be loaded into the reactor direct, but must first be sealed into a container, or "can": prevention of the escape of gaseous fission products into the gas circuit, protection of the uranium from oxidation, and restriction of the deformation caused by the effects of radiation and of heating and cooling.

Early fuel elements, for Bepo and the Windscale reactors, used aluminium as the canning material, but the higher operating temperature in the Calder Hall reactors meant that aluminium would lose so much of its strength that it was no longer suitable. The change from air to relatively inert carbon dioxide as the cooling gas eliminated the fire risk associated with magnesium, and the cans for Calder Hall, Chapel Cross, and the reactors of the civil nuclear power stations now under construction, are of a magnesium alloy known as "Magnox."

The cans arrive at Springfields individually packed and consist of open-ended finned tubes. After degreasing in trichloroethylene, they are examined and comprehensively gauged. A cup is inserted in one end and welded in position automatically in an inert atmosphere of argon. After the efficiency of the weld has been examined and tested, the uranium bar is loaded into the can. Because of the importance of avoiding any surface contamination of the can by particles of uranium, the bars are not allowed into the same shop as the cans, but are fed into them through a hole in the wall. The second end of the can is then sealed up by inserting a cup and welding in the same way as the first end, and the completed can is "pressurized" in an autoclave. The effect of this is to squeeze the can firmly on to the rod, and ensure good transfer of heat from rod to can. Various tests follow, the can is cleaned again, end pieces and braces are attached, and the fuel element, ready for use in a reactor, is packed for despatch.

The illustrations opposite show some of the metallurgical processes in the production of uranium metal at Springfields.

A—One of the red hot reactors being removed from the furnace to the cooling bay, a step in the magnesium reduction of uranium tetrafluoride to uranium metal

B—Mould for uranium fuel rods being placed into a vacuum casting furnace. A bell is later placed over the furnace and the casting of the uranium metal carried out under fairly high vacuum

C—The fuel rod machining line. In the foreground are seen two machines one of which straightens and cleans the rod as received from the casting line and passes it on to the second, a specially designed machine, which carries out three operations in turn—1. Cutting the rod to slightly more than the required length: 2. Cutting a hanging groove to facilitate later operations: 3. Stamping the number of the rod on the end

D—Alpha-annealing apparatus. This is part of the heat-treatment designed to reduce grain size of the uranium metal. An assembly of 30 rods is being placed into a container prior to undergoing the following operations—1. Evacuation of the container and filling with argon: 2. Removed to furnaces on right to be heated and held at constant temperature: 3. Returned to bay on left for controlled cooling

E—Beta-quench apparatus. An uranium rod being removed after receiving heat-treatment designed to reduce the grain size of the uranium metal

F—To prevent uranium contamination of the outside of the fuel elements no uranium is handled or allowed uncovered in the fuel element assembly part of the line. The can is loaded with the uranium bar by passing the rod through a hole in the dividing wall into the can presented to the hole on the other side. If such a contamination occurred the leak detection gear of the reactor would not be so sensitive. This illustration shows the can being held for receipt of the fuel rod

ASTM Standards

THE first of 10 parts of the 1958 "Book of ASTM Standards" has recently been published by the Society. This will be followed by other parts as rapidly as editorial, press work and binding can be completed. The first part off the presses was Part 2—"Non-Ferrous Metals Specifications (Except Test Methods), Electronic Materials." The book contains 251 standards on aluminium and aluminium - base alloys; aluminium wire, rods, and standard conductors for electrical purposes; magnesium and magnesium alloys; zinc and zinc alloys; copper; copper and copper alloy wire and conductors; copper and copper alloy castings; copper alloy wire rods, bars, shapes; copper alloy pipe and tubes; copper and copper alloy plate, sheet, strip; die-castings; lead and lead alloys; nickel and nickel alloys; lead- and tin-base alloys; titanium; solder and bearing metal; zinc; deoxidizers; electrical heating and resistance alloys; metal powder products; electrical contact materials; electrodeposited coatings; materials for electron tubes, electronic devices, and lamps.

It is complete with a detailed subject index and a list of standards in numeric sequence, and to keep it up to date, supplements will be issued late in 1959 and 1960.

Other parts to be issued shortly include Part 3—"Methods of Test for Metals"—and several others dealing with non-metallic materials.

Copies may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa., price $10.

High-Temperature Metal Spraying

Various parts produced with the Plasma Arc Torch. At the bottom left, is a rocket nozzle made of graphite and coated with pure tungsten. Above this are two rocket nozzle liners of different sizes, both made of tungsten. Centre and right, above, are tungsten and tungsten-coated tubes of varying size and wall thickness. Bottom right is a crucible of pure tungsten. The open-work parts are grid cages of high-density tungsten for electronic vacuum tubes

FOR mass-producing extremely hard metal parts using materials hitherto unworkable by conventional means, and/or for applying tough, heat-resistant coatings capable of withstanding temperatures above 2,760°C., a small device less than 2 in. in diameter, the Plasma Arc Torch, has been developed for commercial use by the Linde Company, New York, a division of the Union Carbide Corporation. It is capable of generating controlled temperatures as high as 16,650°C.

In this torch, the plasma state occurs when gas is heated to a temperature high enough for it to be partially ionized. Within the torch itself, the arc column never touches the wall of the nozzle. A layer of cool, non-ionized gas insulates the arc from the nozzle. The arc is struck between a tungsten cathode and usually a water-cooled copper anode.

The torch is operated as follows: The metal or substance to be worked in wire or powder form is passed through an arc that is struck inside the torch, and is converted into a fluid or plastic state. It is then carried out of the torch by inert gases (normally nitrogen, hydrogen or argon, although air can also be used with special shielding of the tungsten) flowing at high velocity, and is finally deposited on the part.

The choice of wire or powder is largely one of convenience or economics.

The part to be coated is chucked and rotated. While it is turning, the coating is applied by the plasma torch. The coating particles, in a plastic state, strike the part at high velocity, giving a good bond and density.

In forming parts, a mandrel is first prepared to the precise internal diameter of the part to be made. Once the mandrel is chucked, the torch applies the selected material and moves back and forth over the length of the part, maintaining a 90° angle to the surface being coated. When the proper thickness has been reached, the torch is stopped and the mandrel is leached out. Brass is often used, and then dissolved in nitric acid. Where acid attacks the coating material, an aluminium mandrel is made and then leached out with caustic. There is apparently no reason, consistent with parts accuracy, why other mandrel materials, including plastics, should not be used.

Once fabricated, parts are given a moderate heat-treatment to improve density and other physical properties. They may or may not require additional polishing or grinding, depending on their application.

The method has been used to produce parts of pure tungsten or tungsten-coated graphite, high density tungsten crucibles for metallurgical purposes, special parts for nuclear work, sensitive electrical contacts, and electronic components and X-ray targets of superior density.

The method is versatile, and pure tungsten, molybdenum, zirconium, and tantalum, the hard carbide materials, and even precious metals including platinum and palladium, have all been successfully used.

Applying a heat-resistant tungsten coating to a missile nose-cone with the Plasma Arc Torch. The tungsten particles are cooled immediately after deposition by sprays of carbon dioxide. Ear muffs are worn as protection against the high-pitched noise of the torch

New Plant & Equipment

Belt Grinding

SMALL, compact and powered with a motor which is economical to run, yet with a capacity the equal of many larger machines, the "Diamant 225" abrasive belt grinding machine is totally enclosed, and has a special drawer to receive grinding dust —thus obviating a common cause of danger and annoyance.

An important feature is the fact that, on opening the side cover, the tension of the belt is automatically slackened for quick changing. The machine is robustly built, and fitted with the latest type belt driving wheel. All parts are readily accessible for easy maintenance, and the pleasing modern lines of the machine will harmonize with any workshop layout.

The 2·5 h.p. motor has a speed of 2,800 r.p.m. The grinding belt is 7 ft. 4 in. long × 3 in. (max.), and the working height is 3 ft. Rubber contact discs, 10 in. in dia., are used. This machine, a Swiss product, is being marketed in this country by The Addison Tool Company Limited, Addison House, 28 Marshalsea Road, London, S.E.1.

Melting

TWO new furnaces, an aluminium bale-out furnace and a brass/bronze lift-out furnace, have been added to the range of equipment manufactured by W. J. Hooker Ltd., 239A Finchley Road, London, N.W.3.

The former is made in capacities from 100 lb.-400 lb. for heavy oil, gas/oil or gas firing. High-quality refractory linings, in standard sizes, make replacement easy. The injector box burner plate is in cast iron to avoid distortion, and is readily removable for easy maintenance.

Flue outlets are hooded and piped to 3 ft. above furnace level in order that heat radiation is kept to a minimum and accidental burns are avoided.

Furnaces are supplied with all pilot lines, valves (air, gas/oil, and pilot), crucible stand and top cover.

The brass/bronze lift-out furnaces are available in sizes from 70 lb. to 350 lb. brass capacity for heavy oil, gas/oil, or gas firing.

A swinging top cover, fully lined with best quality refractory concrete, is provided. Burner equipment affords rapid melting with minimum fuel consumption. The fuel injector plate and run-off box are of heavy duty cast iron, and are readily removable for easy maintenance.

Furnaces are delivered complete (less crucible) with all fuel, air and pilot lines, fuel, air and pilot valves ready for immediate installation.

Square construction is designed to facilitate pit type working and left- or right-hand firing for tandem mounting. Air blast equipment for both types of furnace, with horse power according to furnace capacity, and totally enclosed motor with necessary trunking adjacent to furnace, complete with starter, is available.

Spot Welding

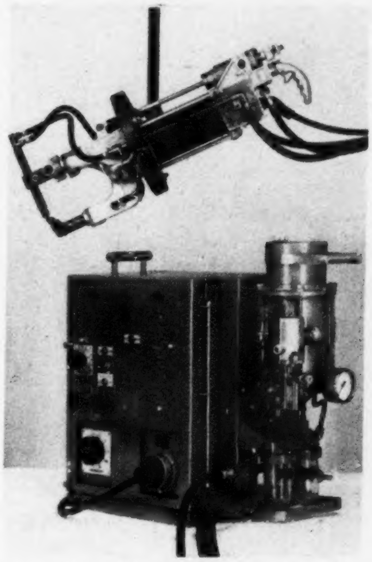
A NEW servo-control unit with solenoid-less pressure switching has been introduced by A.R.O. Machinery Co. Ltd., 190 Castelnau, London, S.W.13. This instrument, the A.R.O. CD3/IV, uses the new Arval pilot valves, and is for use with A.R.O.413 spot welding guns.

The A.R.O. CD3/IV servo-control unit has simplified electrical circuitry, eliminated all mechanical return springs by pneumatic circuits, and, therefore, made for faster operation and less maintenance.

The weld cycle gives variable squeeze, weld and forge time, and weld intensity output control. The electric contactor is for main supply switching. Pressure control in a locked circuit is infinitely variable from 25-900 lb., through air-hydraulic boosting.

Designed for up to 6,000 spots/hr., the equipment and operator are protected by a special monitoring safety circuit.

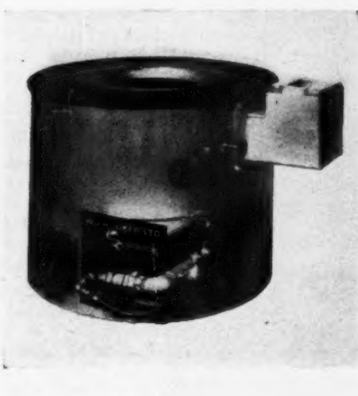
Also introduced recently by this company is the A.R.O. DP.47, a complete weld-press unit designed for single-sided approach welding, based on the DP.45 layout, but with much increased performance and power. It is suitable for many applications,

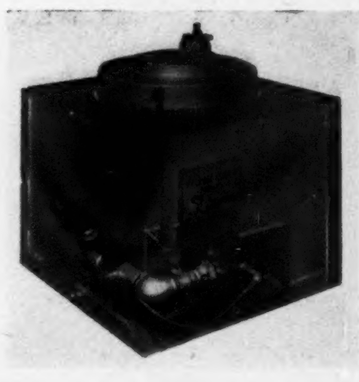


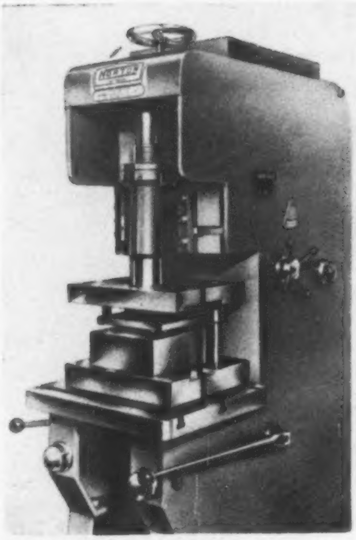
The A.R.O. CD3/IV servo control unit and the A.R.O. 413 spot welding gun

Left: The Diamant 225 abrasive belt grinding machine

Below: The Type B aluminium bale-out furnace (centre) and the Type L brass/bronze lift-out furnace (right) produced by W. J. Hooker Ltd







The Norton $7\frac{1}{2}$ ton hydraulic high speed press

including sheet metal with a plastics-coating on one side. No marks are left to disturb the pattern of the plastics face of the sheet.

New features include:—power input, secondary no-load voltage 5·4 V, secondary amperage, when welding 16+16 S.W.G., 9,200 A. All secondary connections, transformer, electrodes and welding tips are water-cooled. The electrode pitch is variable from 7 in.-$\frac{7}{8}$ in.

Presswork

DESIGNED for high production rates and speed of both operation and set-up, a $7\frac{1}{2}$ ton hydraulic press, introduced by Norton Tool Co. Ltd., of Plough Road, Smallfield, near Horley, Surrey, provides ample bed area, daylights and throat depths normally associated with larger tonnage machines.

The machine is a complete unit within itself, and is only dependent upon a source of electric supply. No additional water supply for oil coolers or air supply for valve operation is required. All auxiliary and ancillary equipment is operated hydraulically from the one power source.

The main frame is made from heavy gauge, deep section steel plates, welded into a rigid one-piece unit.

The bed is detachable from the main frame, and two main designs are offered for standard choice. Both are of T-slot design, 14 in × 20 in., but one has a nesting centre adaptor ring reducing a round through hole of 6 in. diameter to a through hole of 2 in. diameter; the other has a 6 in. square centre hole with no reducing adaptor.

The standard ram No. 1 runs directly in a heavy guide assembly which is adjustable for wear, so that at all times maximum rigidity is maintained even when the ram is extended to full stroke, which is 6 in. The diameter of the ram is $3\frac{1}{2}$ in. and is externally threaded with a heavy square section thread on the top section so that the dead stop may be adjusted to any position within the stroke. This stop is graduated in 0·005 in. increments, and will control the ram consistently to within limits of ±0·0005 in. The top stop is separately adjusted and will also work to close tolerances.

To prevent rotation, a vee-way is machined throughout the entire length of the main ram and a hardened gib, the length of the guide, is adjusted to prevent rotation even against exceptionally high side strains and offset loadings.

An extra ram (No. 2) is basically as above, but with the addition of two heavy guide members set either side of the main ram. Linking the main ram and the two guide members is a top steel platen having an area of 12 in × 6 in. This type of ram is most suitable when it is desirable to anchor the tooling directly on a platen, or if it is necessary to distribute loading in a more uniform manner to the ram. This assembly is interchangeable as a unit with the standard ram assembly, but reduces the daylight by $1\frac{1}{2}$ in.

The pump is of multi-plunger high pressure design, capable of sustaining full pressure working at a continuous rating of 7,000 lb.

The hydraulics consist of two main units only; No. 1, the main control unit, governs the main functions of the machine. This unit also contains the pressure setting valve and the characteristic control combined with the hand and semi-automatic control of the machine. Unit No. 2 controls the auxiliary functions of the machine and the fast approach pressure.

The machine is powered by a $7\frac{1}{2}$ h.p. high speed electric motor, driving via heavy duty V belts to the pump. The drive on the pump is a combined flywheel and V pulley, and a considerable amount of power is available for use on blanking and similar operations from the flywheel itself. This, worked in conjunction with the speed control, is designed to give production rates on certain classes of work far in excess of those which would normally be achieved with the power available. The high speed flywheel, which operates at 1,500 r.p.m., also carries the mounting for the induction fan.

Controls include No. 1 hand control, semi-automatic control, foot control, characteristic control, fast approach, speed control, and pressure control.

Particular interest attaches to the characteristic control—a star wheel situated on the left side of the press which selects the desired requirements of the setter in conjunction with a chart supplied with the machine. This single valve will provide: hand control only; semi-automatic cycling; fully-automatic cycling; fully - automatic cycling with repeat strokes and variations in speed and length of these repeat strokes; fully-automatic cycling with variable dwell at the top of the stroke up to 5 sec., with a proportionate drop at high speeds.

Extraction of Mercury

A PROCESS for extracting mercury by a combined flotation and fluidized-bed roasting process, has been developed on a laboratory basis at the U.S. Bureau of Mines, and although generalized conclusions cannot be drawn from the laboratory studies about its economic feasibility, the 94 per cent mercury recovery compares favourably with the 90 to 95 per cent recoveries usually reported by mercury-plant operators. Grinding the entire ore to liberation size, plus the cost and operation of a concentrator, is a disadvantage, but the relatively small roasting plant required, the fuel saved because a large amount of gangue is rejected before roasting, and the possibility of obtaining an antimony by-product from some ores must be listed as advantages of the combined method.

Fabrication of Refractory Metals—*continued from page* 125

mechanical joints. No published data are available on the welding of rhenium although it is considered feasible on a laboratory level.

In practically all cases, rhenium can be fully softened by heating to 1,100°C. The time involved is approximately 1 hr. Annealing must be conducted in an inert atmosphere, vacuum, or hydrogen.

The metal may be cleaned by mechanical abrasion, and by techniques used for tungsten. It is not known whether special cleaning techniques have been developed peculiar to rhenium.

Acknowledgments

The author wishes to acknowledge the assistance given by A. V. Levy and John Siergiej, of Marquardt Aircraft Company; E. S. Jones, G. S. Hoppin III, of General Electric Company, Aircraft Gas Turbine Division; C. T. Sims and R. I. Jaffee, of Battelle Memorial Institute; H. M. McCullough, of Universal-Cyclops Steel Corporation; and T. A. Havens, of Cleveland Tungsten Inc. Also, the author acknowledges the co-operation of Fansteel Metallurgical Corporation for their part in providing illustrations, and Fansteel Metallurgical Corporation and Metallwerke Plansee for technical data from their publications.

Reference

1 M. J. Cotter; *Atomics*, 1957, Sept., 341.

Industrial News *Home and Overseas*

Export Controls

It was announced by the Board of Trade last week-end that export controls will be entirely removed from a large number of goods as from Monday next, February 16. The goods detailed include virgin aluminium, mercury, mild steel sheels, nickel, silver and silver alloys, and ores and concentrates of copper and molybdenum.

The changes result from amendments to the list of goods subject to an embargo on exports to the Soviet Bloc and China, and from further measures announced for the freer convertibility of sterling and certain European currencies.

It is stated that removal from control of many dollar-costing materials is now possible because of the greater convertibility of European currencies. European countries will no longer be tempted to solve their dollar shortage problem by purchasing commodities of U.S. and Canadian origin from the U.K.

Many entries have been re-defined, in most cases reducing the scope of the control. Export control has been imposed on the following:—(a) To all destinations: lithium compounds, various niobium alloys, nickel wire mesh, and zirconium manufactures; (b) to countries other than the Commonwealth, United States, and the Republic of Ireland: electromagnetic wave-absorbing materials.

Mallory 1000

It has been announced by **Johnson, Matthey and Co. Ltd.** that they are now producing and marketing Mallory 1000, a machinable high density material composed of tungsten, nickel and copper, and made by a special powder metallurgy technique. As the material may be subjected to all normal machining and grinding processes, it is stated to be ideally suitable for the manufacture of components where high mass coupled with high strength and small volume are important considerations.

The company states that components fabricated from Mallory 1000 are finding increasing applications as counterbalances for aircraft control surfaces, balances for flywheels, inertia members in such instruments as accelerometers, and as retarding inertia members, where strong precision-machined rotors are required in a limited space.

A further major application of this material is in radiation shielding. By virtue of its physical structure and its very high density, Mallory 1000 effectively absorbs gamma rays, and can also be used for the shielding of neutron-emitting fission by-products, provided that the intensity of bombardment is relatively low. Such low-intensity neutron bombardment causes only moderate activity in Mallory 1000. It can be supplied in special pressed shapes, as well as in the form of round and rectangular bars.

Non-Ferrous Club

During the course of her address as guest speaker at the monthly luncheon meeting of the **Non-Ferrous Club** at the Queen's Hotel, Birmingham, on Wednesday of last week, Miss Noele Gordon, of the Associated Television organization, said that any critic, whether producer, director, layman or press critic, put forward only an individual viewpoint, and to modify a programme to suit a critic would necessarily ignore the opinions of thousands of viewers. Ultimately, it was the producer's job to shape the programme, and any producer knew only too well that the more he had to do with television the more he realized that there were many ways of looking at any programme.

At this luncheon meeting, a collection was taken on behalf of the Birmingham Federation of Boys' Clubs, and the sum of £19 was handed to Mr. Jack Mould, who received it on behalf of the Federation.

Institute of Technology Course

A special short course on "Developments in Metal Melting and Casting Techniques" is to be held at the **Bradford Institute of Technology,** Bradford, on Friday and Saturday, March 6 and 7. The fee for the course is two guineas, and full details may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

A New Laboratory

As part of their big expansion programme, the **Star Aluminium Company Limited** has recently opened a new four-storey foil development laboratory at Wolverhampton. Its purpose, among other things, will be to experiment, develop and promote new uses of aluminium foil for the industrial and domestic markets.

In announcing this expansion project, Mr. Harry M. Hurst, director and manager of the company, said that the development would put the company in a much better position to meet the growing demand for high quality foil. New coatings and laminations to various materials have created for aluminium foil a vast new market. Already, on their 60-acre site at Bridgnorth, the company's high-speed rolling mills are turning out some of the widest foil (40½ in.) produced in this country.

On this page is illustrated an artist's impression of the new laboratory and office block. A proposed welfare block will be constructed on the right of the present frontage and will be extended on stilts to allow car parking underneath.

Silicon Manufacture

A large-scale development plant for the manufacture of high-quality silicon of semi-conductor grade has been brought into operation by the General Chemicals Division of **Imperial Chemical Industries Limited** on Merseyside. This material, which costs over £100 per lb., has become of commercial importance in the manufacture of semi-conductor devices.

By midsummer this year it is expected that the capacity of this plant will approach some 4,000 lb. per annum. Plans for much larger production are stated to be well advanced. The company can supply silicon in either form. Lump silicon, p-type, of resistivity greater than 200 ohm cm., is now available in quantity. Silicon in rod form for zone refining, deposited direct from vapour and of exceptionally low boron content, is being produced in limited quantities in lengths of 24 in. and diameters up to 1 in.

If the future market requires, it, I.C.I., we understand, is prepared to supply silicon in rod form already zone refined into single crystal rods. To date, much of the silicon used in this country has had to be imported. Now I.C.I. will be able to satisfy the demand, and at a later stage hopes to enter the export field.

A European Tour

As part of its intensive campaign to sell British electronic equipment on the Continent, **E.M.I. Electronics Ltd.** is next month starting an extensive tour of major European industrial centres to demonstrate its new general-purpose analogue computer "Emiac II." The tour is being arranged in collaboration with the com-

This illustration is an artist's impression of the new buildings at Wolverhampton for the Star Aluminium Company Ltd. The illustration shows the new laboratory and office block. A welfare block will be added on the right of frontage shown.

pany's local agents, and will commence at Düsseldorf. Other cities to be visited include Munich, Milan, Stockholm, Paris, and Hanover.

Emiac II is a general-purpose analogue computer of great versatility, which is designed to be built up in module form. It has already, we understand, been used extensively on nuclear reactor, guided missile, and other simulation problems.

Sales Reorganization

News from **Hadfields Limited** is to the effect that their home sales representatives are to act on behalf of the Hadfields group of companies as a whole, including Millspaugh Limited and their subsidiaries.

This arrangement, however, does not include the pulp and paper-making machinery of Millspaugh. This company's range of engineering products—notably fabricated assemblies and centrifugally cast sleeves and rings in a variety of metals, will, however, be in the hands of the Hadfields sales group.

Air Pollution

The next annual meeting of the **Air Pollution Control Association** is to be held in June next at the Hotel Statler, in Los Angeles, California. The meeting will include technical sessions and exhibits. Full particulars relating to this event may be obtained from the executive secretary of the association at 4400 Fifth Avenue, Pittsburgh 13, Pa.

Aluminium Castings

Increasing demand for aluminium castings has been met by **Charles Carr Ltd.** by the installation of additional modern plant in their foundry at Smethwick.

Exhibiting at Toronto

A group display has been organized at the National Industrial Production Show of Canada, to be held in Toronto during May this year, by the **Engineering Centre,** Birmingham, in conjunction with the Board of Trade.

British engineering is the theme of this group display, and among the firms who are participating in the display are the following: Birlec Ltd.; Copper and Alloys Ltd.; Dallow, Lambert and Co. Ltd.; Dewrance and Co. Ltd.; Thos. Firth and John Brown Ltd.; Platt Metals Ltd.; and Yorkshire Imperial Metals Ltd.

A Birmingham Demonstration

During the first week of next month (March), Modern Electrolytic Patents and Processes Ltd. and the European Metal Finishing Division of **Roto-Finish Ltd.,** will be giving demonstrations of Mepp electropolishing, Schoeller ultrasonic cleaning, Scherin plating processes, and Atram phosphating, at the Engineering Centre, Stephenson Place, Birmingham, 2.

Vitreous Enamelling

On Monday next, February 16, the **Institute of Vitreous Enamellers** is holding a meeting at the Engineering Centre, Birmingham, at 7 p.m., when an address will be given by Mr. P. E. Gilroy and Mr. C. Vickers on the subject of "The Future of Aluminium Enamelling."

Gallium Production

An experimental plant for the production of gallium has begun its test run at Ajka, in Eastern Hungary. The gallium (worth about £35 an ounce) is salvaged from the caustic solution used in the extraction of alumina for the aluminium industry.

Rhodesian Copper Output

In the three months ended December 31 last, production of copper at the Roan Antelope mine totalled 13,465 tons, bringing the total for the financial year beginning July 1 to 29,112 tons, against 39,815 tons in the same period of 1957. Output at the Mufulira Copper Mine in the December quarter of 1958 totalled 14,693 tons, bringing production for the last half of 1958 to 33,263 tons, against 47,052 tons in the corresponding period a year earlier. Chibuluma Mines Ltd. produced 3,160 tons in the December quarter, giving a six-month total of 6,901 tons, against 14,563 tons in the previous year.

A Memorial Lecture

A short while ago the Council of the Institution of Industrial Safety Officers decided that the work of **Alexander Redgrave,** the first Factory Inspector, should be commemorated by a memorial lecture to be given by a member of the Institution representing practising industrial safety officers. The first memorial lecture would be delivered to an invited audience of chairmen and directors drawn from leading British industries.

The inaugural lecture will be given by Mr. R. E. Tugman, M.B.E., President of the Institution of Industrial Safety Officers, on February 26 at the Royal Society of Arts. His subject will be: "The Responsibility of Management for the Prevention of Industrial Accidents."

A large part of Mr. Tugman's working life has been spent in the service of industrial safety. Until he retired in 1958 he was Division Safety Officer of Imperial Chemical Industries Ltd., Alkali Division.

Hand Cleansing

A new hand dispenser has recently been placed upon the market by **Deb Chemical Proprietaries Ltd.,** under the trade name of "Spenso." This new dispenser consists of a bracket plugged to the wall on which rests a one-gallon can. The pump unit clips on the bracket and down over the lip of the can, and is tightened in position.

The "Spenso" has a dipstick, from which the contents of the can are easily checked. When empty, each can is replaced by a new filled can. We understand that the price of this complete unit is extremely modest.

Showing at Leipzig

Among the British exhibits to be seen at the forthcoming Leipzig Technical Fair during the first ten days of next month is that provided by **Dowding and Doll Ltd.** The exhibit will include the two British Wiedemann turret punch presses, models RA.41P and R.44..

The RA.41P has been developed especially for rapid and economical production of pierced plates, such as electrical and aircraft panels where heavy expenditure on complicated tooling cannot be justified. The machine operates on the established Wiedemann principle of using standard interchangeable tools mounted in rotating turrets, any tool set being instantly indexed to the operating position.

The model R.44 provides three alternative methods of locating the apertures in the work. On runs of medium length, or on complicated layouts, piercing through a template is generally the most economical method. Coloured lines painted on the templates ensures that all identical openings are pierced consecutively, a similarly coloured tab identifying the appropriate punch. Following these routes minimizes the number of turret movements and reduces handling of the work.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses fell by 167 tons, and were distributed as follows at the end of last week:—London, 5,925 tons; Liverpool, 7,106, and Hull, 1,430.

Stocks of refined copper rose by 884 tons, and were as follows:—London, 2,149 tons; Liverpool, 2,069; Birmingham, 227, and Manchester, 1,150.

Shell Moulding

Issued by The Engineering Societies Library, of New York, U.S.A., is a bibliography on shell moulding, which is available at the price of $2.00.

This bibliography is a selected list of over 200 annotated references to books, reports and magazine articles published from 1952 to 1958, covering all aspects of shell moulding, including theory, principles, production practice in large and small ferrous and non-ferrous foundries, materials, design, testing methods, equipment, and costs. There are Papers on the application of shell moulding to the manufacture of crankshafts and other automotive parts, waveguides, heaters, electric motor parts, gears, seal rings, valves, pipe flanges, bells, etc.

Canadian Minerals

Sharper competition from countries with lower production costs is facing Canada's mineral producers, the Canadian Metal Mining Association has been told by Mr. J. B. Redpath, Association President. He said: "Many countries—some of which may be described as undeveloped—are known to have mineral resources in abundance, and many of these now are being developed. In many such countries production costs, and particularly wage rates, are only a fraction of those to which we have become accustomed in North America."

Mr. V. C. Wansbrough, vice-president and managing director of the Association, said that for the mining industry, as for the economy as a whole, continued inflationary pressures were very dangerous indeed. Any "honeymoon" enjoyed in the immediate post-war years was long since past. Competition for world markets was keener now than since before the war.

Polish Copper

Copper deposits now being exploited in Poland are of relatively low grade, and domestic output is far from sufficient to cover requirements, which must be met by imports and re-working of copper scrap. Currently, output of domestic concentrate is running at around 6,000 metric tons annually, and it is hoped to increase this figure, from ore from the older deposits, to 12,000-13,000 tons annually by 1965. However, this will still be far below the country's actual needs, to judge from electrolytic copper production figures, which for 1956 were 20,300 tons and for 1957, 19,900 tons.

Meanwhile, much hope is being placed in the recently-discovered Glogow deposits. However, although these are of high metal content, it is understood that

exploitation presents some very awkward problems, and that considerable time must elapse before ore extraction can start. In fact, it is understood that the Polish authorities have already allocated 30 million dollars for copper imports in 1965 and 50 million for 1975, although the Glogow deposits have been described as so rich that they will eventually make Poland independent of foreign supplies.

The Polish Government has instructed the Ministry for Heavy Industries to draft an overall development plan for the Glogow area, and to accelerate geophysical work there. By the end of the current year, the Ministry will have worked out what machinery and equipment will have to be brought in from abroad to equip the mines.

A Scrap Contract

It is understood that, consequent upon the decision of the London Transport Executive to replace its electric trolleybus system with diesel buses, a contract has recently been signed by the L.T.E. with George Cohen Sons and Company Ltd. for the whole of the trolleybus fleet of some 1,400 vehicles.

This is an important contract for the "600" Group, which has been responsible for scrapping many of the old types of omnibus, and also of the London trams. Many thousands of tons of metal will be recovered as a result of this new contract, and, no doubt, the metal recovered will be of considerable assistance in the construction of new buses.

Austrian Aluminium

It is learned from reliable sources in Vienna that the Austrian aluminium industry has asked the Austrian Government to protect it against East Bloc "dumping" of unworked aluminium on the Austrian markets. The industry proposed to make unworked aluminium imports subject to special approval.

The industry declared that, due to an increase in its production costs, the competitive position of Austrian virgin aluminium on the international market had worsened. On the domestic market, home-based industry was in danger since the Soviet Bloc was offering the metal at prices considerably below the world market level. It is understood that the introduction of import permits for lead and zinc is also under consideration.

Name Plate Fixing

A new method of fixing name plates on machines, products, and on goods in transit has recently been introduced by **Evode Ltd.** A double-sided adhesive tape called "Twinstik" is used for this method. The name plates are backed by the adhesive tape, which is protected by a specially-treated paper. This protective cover is stripped off to expose the other pressure-sensitive surface, and the plate is then pressed into position.

The makers state that the adhesive which impregnates the tape is extremely strong and has excellent ageing properties, so there can be no danger of the plate coming unstuck. Materials to which the tape will adhere are said to be practically limitless, since it makes a permanent bond to all metals, wood, plastics, brickwork, plaster, and cement.

Articles backed with this material can also be fixed to comparatively uneven surfaces because of the tape's capacity to fill irregularities. Absence of solvents in the adhesive is also said to make possible the fixing of objects with "Twinstik" to cellulosed surfaces.

German Aluminium

Official final figures for 1958 put West Germany's production of virgin aluminium at 136,766 metric tons, some 11·1 per cent down on output for the preceding year. Producers attribute this decline mainly to the increase in imports of foreign virgin metal to 58,000 metric tons, compared with 40,000 in 1957. Foreign deliveries of aluminium alloys rose very sharply to 8,000 metric tons, from 1,500 in 1957. This was despite full tariff protection for this category of products. In the case of unalloyed metal, the previously-existing duty-free import quota of 40,000 metric tons has been maintained for 1959.

Meanwhile, official figures for production of aluminium semis in 1958 is 165,000 metric tons—4·8 per cent up; that for aluminium castings, 72,935 tons—8·4 per cent up, and that for aluminium used in electrical conductors, 16,547 tons—13·7 per cent down.

New Plant for Dohm

To meet the increased demand for Dohmfrac pre-coated resin sand for shell moulding and shell core production, a third manufacturing plant is now in full production at the Burslem works of **Mellor Mineral Mills,** one of the Dohm group of companies. Known as the No. 3 plant, the new premises now permit large batch production of the material.

European Zinc and Lead Production

Refined zinc production in the O.E.E.C. producer countries, i.e. Austria, Belgium and the Belgian Congo, France, Germany, Italy, the Netherlands, Norway and the United Kingdom, totalled 71,588 metric tons in December, 1958, as compared with 67,566 metric tons in November, 1958. Production level decreased by about 3 per cent as compared with December, 1957.

Of the December, 1958, total, 27,751 metric tons were high grade and special high grade zinc (of at least 99·95 per cent zinc content) and 43,837 metric tons were other grades (G.O.B. debased).

Total pig lead (minimum content 99·95 per cent) production in O.E.E.C. producer countries, i.e. Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, the United Kingdom and Sweden, as well as in Morocco and Tunisia, amounted to 59,569 metric tons in December, 1958, as compared with 55,812 metric tons in November, 1958.

As compared with December, 1957, there is an increase of about 15 per cent in the level of production.

Uganda Copper

Production of copper in Uganda in 1958 reached 10,915 tons, compared with 7,468 tons in 1957. Kilembe Mines, Uganda's only copper producer, increased its output in 1958, and a further expansion programme has now been started.

West German Aluminium

Foundry production of aluminium in Federal Germany fell by 11·1 per cent during 1958 compared with 1957, according to official figures. It amounted to 136,766 tons.

The main reason for the reduction is said to be the increase in imports, which rose to 58,000 tons from 40,000 tons of pure aluminium in 1957, and to 8,000 tons from 1,500 tons of aluminium alloys in 1957.

Expansion in America

In association with Engis Equipment Company of Chicago, **Hilger and Watts Ltd.** are forming an affiliated U.S. company—Hilger & Watts Inc. The offices of this company will be at 431, South Dearborn Street, Chicago 5, Ill., U.S.A. This step has been taken by reason of the increasing volume of the company's sales in North America and the intention to press forward with further expansion.

Forthcoming Meetings

February 14 — Institute of British Foundrymen. East Midlands Branch. College of Technology and Commerce, Leicester. "Metallurgical Considerations Governing Choice of Melting and Annealing Plant for New Malleable Foundry." H. G. Hall. 6 p.m.

February 14 — Institute of British Foundrymen. Scottish Branch. Royal College of Science and Technology, George Street, Glasgow. "Safety in the Foundry." H. P. Millar. 3 p.m.

February 16—Institute of Metal Finishing. London Branch. Northampton College of Technology, St. John Street, London, E.C.1. "Recent Advances in Cold Phosphating." N. H. Mack and H. P. Evans. 6.15 p.m.

February 17 — Institute of British Foundrymen. Slough Section. Lecture Theatre, High Duty Alloys Limited, Slough. "Patternmaking Progress." B. Levy. 7.30 p.m.

February 17—Institute of Metals General Meeting. The College of Technology, Gosta Green, Birmingham, 4. Informal Discussion on "The Economic Protection and Packaging of Non-Ferrous Metals in Storage and Transit." 10.30 a.m.

February 17—Institute of Metal Finishing. South-West Branch. Spread Eagle Hotel, Gloucester. "Applications of Modern Metal Finishing Processes." H. L. Watts. 6.30 p.m.

February 18—Institute of Metal Finishing. Organic Finishing Group. Exchange and Engineering Centre, Stephenson Place, Birmingham, 2. "Recent Developments in Paint Application" and "Curtain Coating"; F. W. Summerland. "Electrostatic Hand Spraying." R. Tilney. 6.30 p.m.

February 18 — Manchester Metallurgical Society. Manchester Room, The Central Library, Manchester. "High Temperature Alloys." D. R. Wood. 6.30 p.m.

February 19 — North-East Metallurgical Society. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. "Metallurgical Education." G. V. Raynor. 7.15 p.m.

February 19—Institute of Metals. Birmingham Local Section. College of Technology, Gosta Green, Birmingham, 4. "Materials for Reactors." B. C. Woodfine. 6.30 p.m.

February 19 — Institute of British Foundrymen. Northampton Section. Hind Hotel, Wellingborough. "Manufacture of Aircraft Engine Castings." C. W. Hicks. 7.30 p.m.

Metal Market News

COPPER and tin were both in movement last week, the former on a downward course for most of the time and the latter continuing its prolonged upward climb, which took it over £770. Copper, on the other hand, fell below £230 before a modest recovery set in, and was talked lower, some people saying that we should see the quotation at £220. A favourable development was the narrowing of the backwardation. This weakness, strangely enough, followed an advance in the domestic producers' price to 30 cents, so that the price structure in the States levelled off at that figure. Business on this side of the Atlantic has admittedly been pretty poor, but it is rather disconcerting that the market should give way so sharply. The turnover was fairly heavy at about 12,500 tons, apart from a not inconsiderable tonnage done on the Kerb. On the whole, the tone of the American Copper futures market was fairly steady, but fluctuations were seen in sympathy with price movements in London. Stocks of copper in L.M.E. warehouses advanced by 350 tons to 4,711 tons, a meagre enough total, but the increase was enough to narrow the backwardation. What apparently touched off the decline was the announcement that the Potrerillos strike was "off," as a settlement had been reached in the dispute. The market is awaiting with interest the January statistics, which may be available next Monday. In the meanwhile, it is currently reported that electrolytic copper wirebars have been delivered on the market.

As already mentioned, a moderate recovery was seen in copper at the end of the week, but, nevertheless, there was a loss of £8 5s. 0d. in cash at £232 15s. 0d., while three months declined by £4 5s. 0d. to £233. The pleasing thing about events last week was the re-appearance of a modest contango on Friday in place of the backwardation, and it must be assumed that the stock position is now going to mend. As we write, the latest figures are not to hand, but it certainly looks as though another increase will be seen. Comex closed the week quietly, Friday's trading close showing a small loss compared with Thursday, in spite of the better tendency here. Only 65 lots changed hands. No doubt the low point reached in Whittington Avenue on Thursday attracted buyers, and physical business was reported following the drop. So the pattern of the copper price begins to emerge at around £230 low and £240 high. Variations above and below will doubtless occur, but for the present this range of about £10 seems to be the outlook. The most likely cause of a rise in the quotation would, of course, be the threat of a major strike at some centre of production.

Tin continued its steady advance last week, the close at £772 for cash and £772 10s. 0d. three months showing a gain of £5 10s. 0d. in prompt and of £7 in the forward position. Here again, as in the case of copper, a backwardation has been replaced by a contango. The turnover was 1,845 tons. Lead suffered a loss of only 2s. 6d. for prompt and of 5s. forward on a turnover of 6,525 tons, closing prices being £70 17s. 6d. February and £71 10s. 0d. May. Zinc closed 5s. up at £73 5s. 0d. February, and unchanged May at £72, on a turnover of 5,200 tons.

Birmingham

The general trade situation has not changed much in the Birmingham area. Unemployment is still increasing in the metal trades, and exporters of small metal goods find it very difficult to compete in overseas markets. Not only are tariff barriers high, but British prices are being undercut by makers in Germany and Japan. The most encouraging sign is the substantial business booked by makers of heavy electrical equipment, which promises to maintain full employment in this industry for a long way ahead. The smooth running of the motor car factories has again been interrupted by labour disputes within the past week. This is particularly disappointing at a time when the industry is well situated for orders and represents one of the biggest consumers of metal, both ferrous and non-ferrous.

Consumers of steel have noticed a marked speeding up of delivery of nearly all products. Whereas months elapsed previously between placing of orders and fulfilment, it is often now a matter of weeks, or even days. There are exceptions, notably plates and sheets, for which there is still a very strong demand. The structural steel market is urgently in need of a stimulus. Orders for building steel have declined sharply in the last three months. There is a fair business in the heavier type of castings for engineering work, and the light foundries report a slight improvement in demand. The re-rolling steel mills are still working short time.

New York

On the New York market, copper futures were barely steady on light week-end profit-taking. Physical copper continued firm, with demand brisk. Custom smelters reported good sales. Leading producers are sold out for February, and two of them have not yet opened their books for March.

According to the Bureau of Mines, mine production of copper in the United States in 1958, at 980,304 tons, dropped 10 per cent from 1957. Voluntary curtailment by major producers was mainly responsible for the decrease. However, operations rapidly increased at most of the large western mines, and production in the last quarter exceeded a monthly rate of 93,500 tons, with December output reaching almost 95,000 tons.

Tin was steady, but quiet. Lead was quiet, but for zinc moderate sales were reported.

On the New York silver market, the open market price continued at 90⅜ cents a fine ounce.

Leading trade sources in New York say domestically-produced lead continues in slow demand, and that the 12 cent price is increasingly shaky. One leading seller said: "The twelve cent level hangs by a thin thread, and a decrease could develop any time."

Industry sources ascribed the weak undertone to continued high foreign mine production and the, thus far, unsuccessful attempts by the United Nations lead-zinc group to solve the problems of world over-production. Other factors are the disappointing results of the U.S. Government's barter programme and the spread between the U.S. lead price and the London Metal Exchange quotation.

Trade sources said that the U.S. import quotas, which limit lead imports to 80 per cent of the average imports during the five-year span 1953-57, had not eased the situation. Foreign lead was still being offered to U.S. consumers in substantial volume and, there being no quota on imports of semi-finished and finished lead products, such imports were increasing.

With the lower lead prices prevailing abroad, these items could be offered in the U.S. at prices several cents a lb. below similar items produced domestically, these sources added. Also, foreign metal unable to land in U.S.A. because of the import quota was further depressing the foreign centres and increasing the price spread between U.S. and foreign markets. London metal could be landed a full cent below the domestic price, trade circles said.

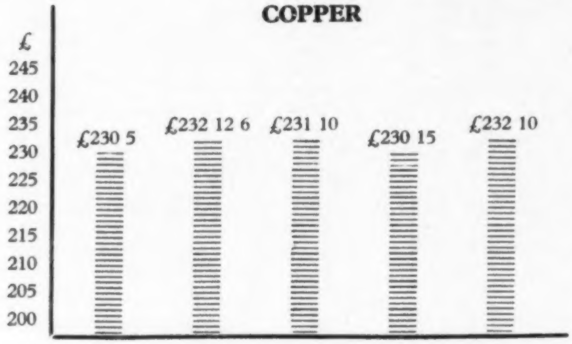
Tokyo

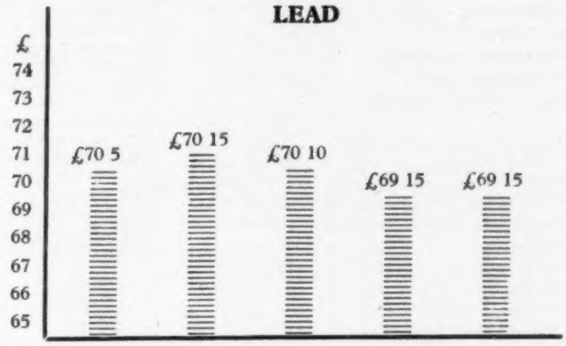
In view of the recent increase in the American producers' price, the Nippon Mining Company, a leading copper producer in Japan, has announced that it has raised its price of electrolytic copper by 10,000 yen to 290,000 yen per ton, ex mill.

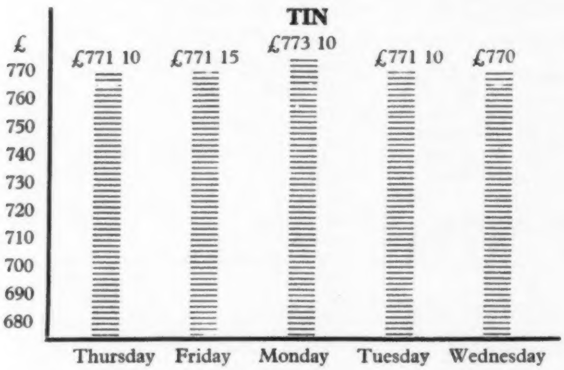
This was the second increase in the price since November last year, when it was increased by 20,000 yen to 280,000 yen per ton. Five other leading copper producers in this country are expected to follow suit.

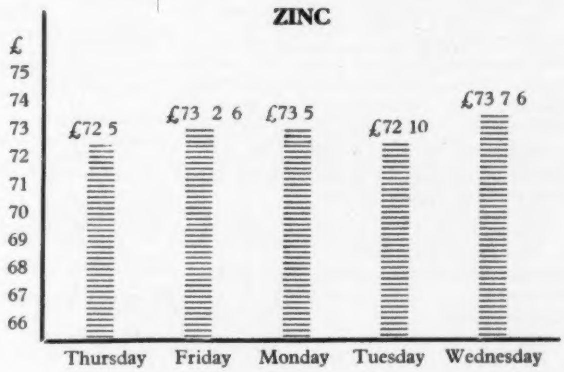
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 5 February to Wednesday 11 February 1959









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	157 10	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					220	165 0	445	262 10			29.00	232 0
Cadmium					1,350	1,012 10					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							450	265 10				
Electrolytic	33.00	242 17 6	29.00	239 10	331	248 5			2.85	242 5	30.00	240 0
Lead			11.50	95 0	103	77 5	170	100 7 6	.90	76 10	12.00	96 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	110.75	815 2 6			1,109	831 15	1,470	867 7 6	9.15	777 15	101.62	813 0
Zinc												
Prime western			11.75	97 0 0							11.50	92 0
Highgrade 99.95			12.35	102 0 0								
Highgrade 99.99			12.75	105 7 6								
Thermic					108.00	81 0						
Electrolytic					116.00	87 0	167	98 10 0	.94	80 0	12.75	102 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 11/2/59)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite per unit			—	
Copper H.C. Electro	ton	232	10	0
Fire Refined 99·70%	„	231	0	0
Fire Refined 99·50%	„	230	0	0
Copper Sulphate	„	76	0	0
Germanium	grm.		—	
Gold	oz.	12	9	7½
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	69	15	0
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	248	0	0
Mercury	flask	74	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	19	10	0
Rhodium	„	40	0	0
Ruthenium	„	14	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	4⅞
Tellurium	lb.		15	0
Tin	ton	770	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	72	6	10½
Dust 95/97%	„	109	0	0
Dust 98/99%	„	115	0	0
Granulated 99+%	„	97	6	10½
Granulated 99·99+%	„	111	6	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	142	10	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	186	0	0

†Average selling prices for mid October

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	227	0	0
BSS 1400 AB.2	„	240	0	0
***Brass**				
BSS 1400-B3 65/35	„	150	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	203	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	185	0	0
(86/7/5/2)	„	195	0	0
(88/10/2/1)	„	243	0	0
(88/10/2/½)	„	252	0	0
Manganese Bronze				
BSS 1400 HTB1	„	188	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
B.S. 1400 P.B.1.(A.I.D. released)	„	282	0	0
B.S. 1400 L.P.B.1	„	207	0	0
Phosphor Copper				
10%	„	250	0	0
15%	„	253	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	359	9	0
Grade D Plumbers	„	289	6	0
Grade M	„	394	9	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	104	11	3
Mazak V	„	108	11	3
Kayem	„	114	11	3
Kayem II	„	120	11	3
Sodium-Zinc	lb.		2	6

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	10½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	249	10	0
Extruded Bar	lb.		2	0
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	185	0	0
Condenser Plate (Naval Brass)	„	196	0	0
Wire	lb.		2	7⅞
Copper Tubes	lb.		2	3¾
Sheet	ton	268	0	0
Strip	„	268	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	283	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	6½
Lead Pipes (London)	ton	112	5	0
Sheets (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	8
Wire 10%	„		4	2¾
Phosphor Bronze				
Wire	„		4	0½

Titanium (1,000 lb. lots)			
Billet over 4" dia.-18" dia.	lb.	63/-	64/-
Rod 4" dia.-·250" dia.	„	75/-	112/-
Wire under ·250" dia.-·036" dia.	„	146/-	222/-
Sheet 8′ × 2′ × ·250"-·010" thick	„	88/-	157/-
Strip ·048"-·003" thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	107	15	0
Strip	„		nom.	

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Nov., 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium	
Production	2,292
Imports	18,584
Despatches to consumers	21,618
Secondary Aluminium	
Production	9,159
Virgin content of above	953
Despatches (including virgin content)	9,578
Secondary in Consumption (per cent)	
Wrought products	6·6
Cast products	81·8
Destructive uses (aluminium content irrecoverable)	72·2
Total consumption	26·3
Scrap	
Arisings	12,309
Estimated quantity of metal recoverable	8,362
Consumption by:	
(a) Secondary smelters	11,489
(b) Other uses	1,345
Despatches of wrought and cast products	
Sheet, strip and circl s	12,960
Extrusions (excludir.g forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,915
(b) Tubes (i) extruded	252
(ii) cold drawn	607
(c) (i) Wire	3,059
(ii) Hot rolled rod (not included in (c) (i)	96
Forgings	294
Castings: (a) Sand	1,569
(b) Gravity die	3,588
(c) Pressure die	1,570
Foil	2,143
Paste	293
Magnesium Fabrication	
Sheet and strip	10
Extrusions	80
Castings	160
Forgings	16

Ratcliffs (Great Bridge) Ltd.

For the year 1958, the dividend on the year's working remains at 10 per cent, the same as in 1957, a final dividend of 7½ per cent having been declared. Group net profit was £236,561 (£300,721), after tax of £137,750 (£200,000). Parent company profit £152,200 (£202,177).

Rhodesian Profits

Rhodesian Selection Trust reports an estimated profit before tax for the second quarter to December 31, 1958, of £949,000, being £960,000 from Mufulira and £15,000 from Chibuluma, less expenditure of £16,000. Total profit for six months is estimated at £1,758,000.

Roan Antelope reports an estimated profit before tax for the December quarter of £997,000.

Reynolds Metals

Shareholders of Reynolds Metals Company, U.S.A., have now authorized the issue of an additional two million shares to help pay for the recent acquisition by the company of Ordinary stock in the British Aluminium Company Limited. The authorization was for one million shares of second Preferred stock and one million shares of common stock. It has been estimated that Reynolds invested 45 million dollars to win the financial battle it waged together with its British partner, Tube Investments Limited, in buying a majority interest in British Aluminium.

Trade Publications

Non-Ferrous Castings. — Charles Carr Ltd., Grove Lane, Smethwick, 40.

Recent publications issued by this company give much useful information regarding the range of non-ferrous castings in standard or special alloys which are produced by the company. These include gunmetal, phosphor bronze, leaded bronze, aluminium bronze, manganese bronze, brass, etc. Details are also given of the "Lily" brand chill-cast phosphor bronze, cored or solid; also Carr-cast Monel. Another leaflet refers to the company's aluminium castings.

Data Processing and Spectrochemical Analysis.—Hilger and Watts Limited, 98 St. Pancras Way, London, N.W.1.

Two brochures have recently been distributed by this company. The first deals with direct-reading spectrographs, in which a wide range of instruments is provided, and the second brochure provides information on digitizers and other equipment for data processing.

Hot Metal Receivers. — Monometer Manufacturing Co. Ltd., Savoy House, 115 Strand, London, W.C.2.

A four-page coloured brochure details this company's forehearth or mobile tilting receivers, either motorized or manually operated. Mobile receivers may be fed continuously from one or a number of cupolas by means of launders. Forehearth receivers are fed direct from the cupolas by means of launders, and hold the metal at casting temperatures for long or short periods, ensuring a constant supply of metal for the intermittent feeding of ladles for the conveyor casting system. Several illustrations of installations are included in the brochure.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 10/2/59.

	£
Aluminium	
New Cuttings	145
Old Rolled	125
Segregated Turnings	94
Brass	
Cuttings	156
Rod Ends	140
Heavy Yellow	115
Light	110
Rolled	140
Collected Scrap	113
Turnings	133
Copper	
Wire	204
Firebox, cut up	198
Heavy	194
Light	189
Cuttings	204
Turnings	184
Braziery	156
Gunmetal	
Gear Wheels	180
Admiralty	180
Commercial	157
Turnings	152
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	530
Phosphor Bronze	
Scrap	157
Turnings	152
Zinc	
Remelted	55
Cuttings	46
Old Zinc	35

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

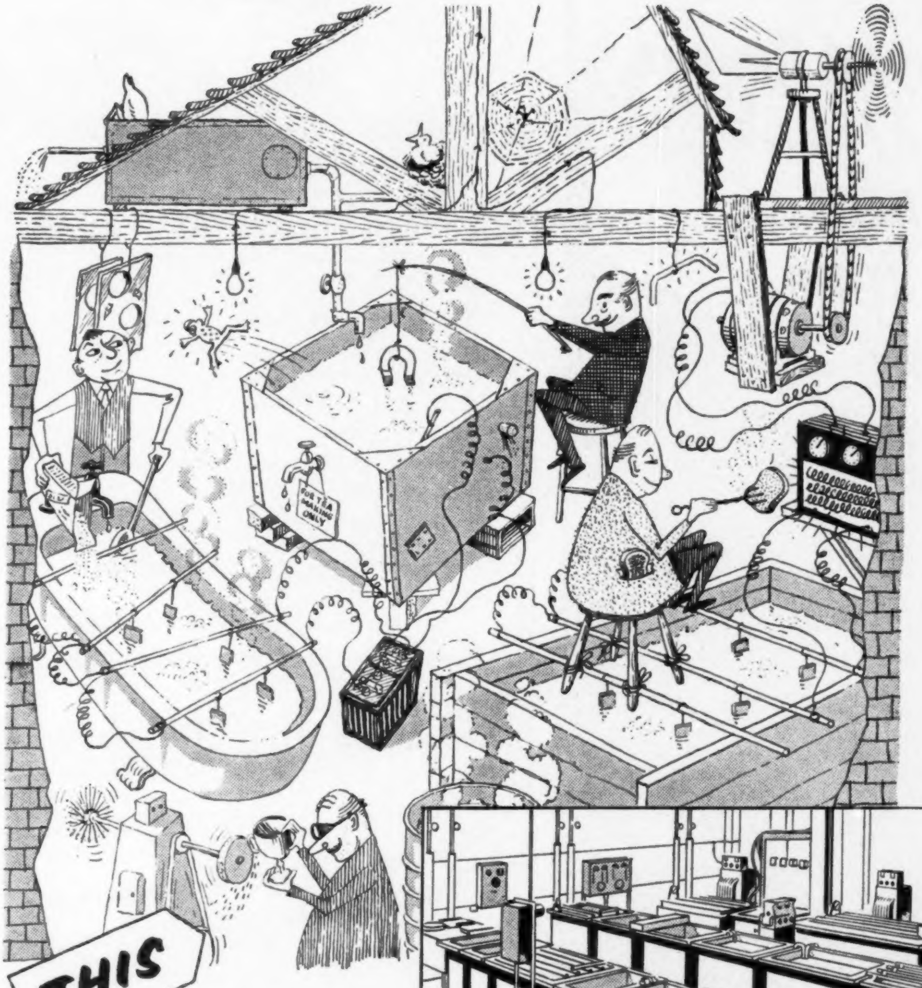
West Germany (D-marks per 100 kilos):		
Used copper wire	(£192.15.0)	220
Heavy copper	(£188.7.6)	215
Light copper	(£162.0.0)	185
Heavy brass	(£105.2.6)	120
Light brass	(£87.12.6)	100
Soft lead scrap	(£57.0.0)	65
Zinc scrap	(£39.10.0)	45
Used aluminium unsorted	(£78.16.0)	90
France (francs per kilo):		
Copper	(£195.0.0)	260
Heavy copper	(£195.0.0)	260
Light brass	(£116.5.0)	155
Zinc castings	(£47.5.0)	63
Lead	(£67.10.0)	90
Tin	—	
Aluminium	(£101.5.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£197.12.6)	335
Aluminium copper alloy	(£126.17.6)	215
Lead, soft, first quality	(£80.5.0)	136
Lead, battery plates	(£44.17.6)	76
Copper, first grade	(£209.10.0)	355
Copper, second grade	(£197.12.6)	335
Bronze, first quality machinery	(£203.10.0)	345
Bronze, commercial gunmetal	(£174.0.0)	295
Brass, heavy	(£138.12.6)	235
Brass, light	(£126.17.6)	215
Brass, bar turnings	(£129.17.6)	220
New zinc sheet clippings	(£57.5.0)	97
Old zinc	(£42.10.0)	72

THE STOCK EXCHANGE

Selective Buying Of Industrials On Moderate Scale. Steels Firmer

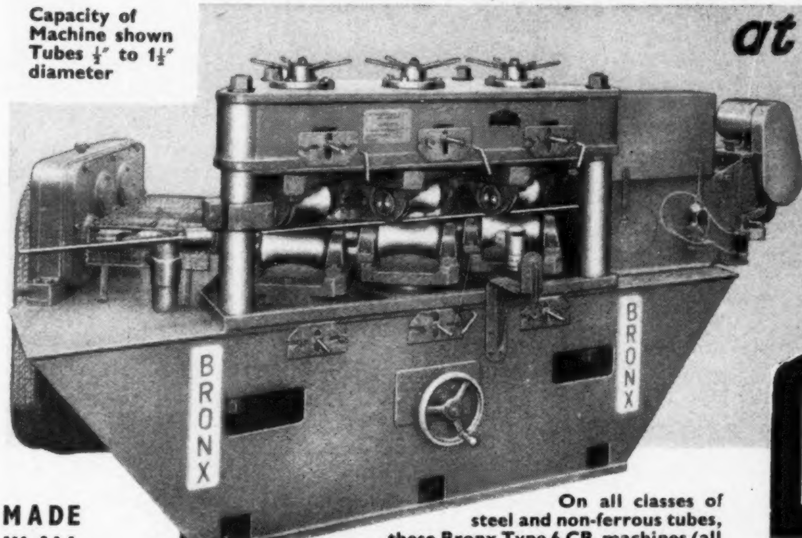
ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 10 FEBRUARY	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	24/10½	+4½d.	9	10	7 4 9	24/10½	23/3	24/9	17/6
400,000	2/-	Anti-Attrition Metal	1/6		4	8½	5 6 9	—	—	1/9	1/3
41,305,038	Stk. (£1)	Associated Electrical Industries ...	54/-	—9d.	15	15	5 11 0	59/-	54/-	58/9	46/6
1,609,032	1	Birfield	57/6		15	15	5 1 6	59/-	57/1½	62/4½	46/3
3,196,667	1	Birmid Industries	72/9	—1/-	17½	17½	4 16 3	76/10½	73/-	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	36/6		11	10	6 0 9	40/4½	36/6	39/-	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/-		5	5	6 13 3	—	—	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/9		6	6	6 15 3	18/1½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	27/6		10	12½	7 5 6	28/3	27/6	28/9	24/-
300,000	1	Ditto Pref. 5%	15/-		5	5	6 13 3	15/3	15/-	16/-	15/-
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	—	—	20/4½	19/-
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/3	—3d.	6	6	6 4 9	19/7½	19/1½	20/-	18/4½
15,000,000	Stk. (£1)	British Insulated Callender's Cables	48/6	+2/3	12½	12½	5 3 0	52/-	47/6	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	50/3	+3d.	10	10	3 19 6	54/7½	49/3	52/-	28/3
600,000	Stk. (5/-)	Canning (W.) & Co.	25/-		25+ *2½C	25	5 0 0	25/6	24/10½	25/3	19/3
60,484	1/-	Carr (Chas.)	1/6		12½	25	8 6 9	—	—	2/3	1/4½
150,000	2/-	Case (Alfred) & Co. Ltd.	4/7½	—3d.	25	25	10 16 9	5/0¾	4/7½	5/3	4/-
555,000	1	Clifford (Chas.) Ltd.	22/6		10	10	8 17 9	22/6	22/6	22/-	16/-
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	—	—	16/-	15/-
250,000	2/-	Coley Metals	3/-		20	25	3 6 9	3/1½	2/10½	4/6	2/6
8,730,596	1	Cons. Zinc Corp.†	63/6		18¾	22½	5 18 0	67/6	61/3	65/3	41/-
1,509,528	1	Davy & United	92/6	+3/9	20	15	4 6 6	92/6	86/-	87/-	45/9
2,915,000	5/-	Delta Metal	26/6	+1/10½	30	*17½	5 13 3	26/6	24/1½	25/-	17/7½
4,600,000	Stk. (£1)	Enfield Rolling Mills Ltd.	46/6	+1/-	12½	15B	5 7 6	46/6	36/7½	38/-	22/9
750,000	1	Evered & Co.	30/-		15Z	15	6 13 3	30/-	30/-	30/-	26/-
18,000,000	Stk. (£1)	General Electric Co.	32/3		10P	12½		40/3	32/3	40/6	29/6
1,500,000	Stk. (10/-)	General Refractories Ltd.	38/3		20	17½	5 4 0	38/7½	37/3	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	65/-	—1/6	15	15	4 12 3	66/6	65/-	67/6	61/-
750,000	5/-	Glacier Metal Co. Ltd.	6/9		11½	11½	8 10 3	7/1½	6/7½	8/3	5/-
1,750,000	5/-	Glynwed Tubes	19/1½	+3d.	20	20	5 4 6	19/3	16/4½	18/1½	12/10½
5,421,049	10/-	Goodlass Wall & Lead Industries ...	30/-	+9d.	13‖	18Z	4 6 9	31/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	80/6		20	17½	4 19 3	83/9	75/-	57/9	45/-
396,000	5/-	Harrison (B'ham) Ord.	15/3	+3d.	*15	*15	4 18 3	15/3	15/-	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	—	—	19/9	18/4½
1,075,167	5/-	Heenan Group	7/7½	—1½d.	10	10‡	6 11 3	8/3	7/7½	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	34/1½	+4½d.	12Z	10	4 13 9	38/3	33/9	38/-	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	16/9	+3d.	5	5	5 19 6	16/9	16/-	17/1½	16/-
14,584,025	**	International Nickel	160½	—2½	$2.60	$3.75	2 17 6	163	153	169	132¾
860,000	5/-	Jenks (E. P.), Ltd.	9/9	+1/-	14	27½ϕ	7 3 6	10/-	8/9	10/-	6/7½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/4½	16/9	15/-
3,987,435	1	Ditto Ord.	45/6		10	10	4 8 0	45/6	44/3	47/-	36/6
600,000	10/-	Keith, Blackman	27/6	+2/6	17½E	15	6 7 3	27/6	25/-	28/9	15/-
320,000	4/-	London Aluminium	5/6	—1½d.	10	10	7 5 6	6/-	5/3	6/-	3/-
2,400,000	1	London Elec. Wire & Smith's Ord. ...	70/-	+6d.	15	12½	4 5 9	74/6	70/6	74/-	39/9
400,000	1	Ditto Pref.	24/9		7½	7½	6 1 3	25/3	24/3	24/3	22/-
765,012	1	McKechnie Brothers Ord.	45/-		15	15	6 13 3	45/-	43/6	45/-	32/-
1,530,024	1	Ditto A Ord.	42/6	+6d.	15	15	7 1 3	43/6	42/-	45/-	30/-
1,108,268	5/-	Manganese Bronze & Brass	14/3	+3d.	20	27½‡	7 0 3	14/3	13/9	14/1½	8/9
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	69/-	+9d.	11	11	3 3 9	73/9	66/6	73/3	40/6
415,760	Stk. (2/-)	Metal Traders	8/6		50	50	11 15 3	9/1½	1/6	9/-	6/3
160,000	1	Mint (The) Birmingham	22/-		10	10	9 1 9	22/-	22/-	22/9	19/-
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	75/6	69/-	83/6	69/-
3,705,670	Stk. (£1)	Morgan Crucible A	43/6	—6d.	10	10	4 12 0	45/9	43/6	45/-	34/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/-		5½	5½	6 2 3	18/6	18/-	18/-	17/-
2,200,000	Stk. (£1)	Murex	44/6	—1/3	17½	20	7 17 3	48/6	42/-	58/9	46/-
468,000	5/-	Ratcliffs (Great Bridge)	10/9	—3d.	10	10	4 13 0	11/3	11/-	11/1½	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	27/9		20	27½D	7 4 3	—	—	27/3	24/6
1,365,000	Stk. (5/-)	Serck	18/1½		15	17½	4 2 9	19/-	18/-	18/7½	11/-
6,698,586	Stk. (£1)	Stone-Platt Industries	43/-		15	12½	6 19 6	46/9	45/-	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	16/1½		5½	5½	6 16 6	16/7½	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	80/-	+2/3	17½	15	4 7 6	83/3	72/-	86/-	48/4½
41,000,000	Stk. (£1)	Vickers	34/-	—7½d.	10	10	5 17 9	37/-	34/-	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/-		5	5	6 13 3	15/0¾	14/7½	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/3		*5	*5	6 18 9A	22/7½	21/7½	23/-	21/3
2,200,000	1	Ward (Thos. W.), Ord.	83/6	—6d.	20	15	4 15 9	87/6	83/6	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	41/3	+1/6	10	10	4 17 0	47/-	39/9	46/6	32/6
225,000	2/-	Wolverhampton Die-Casting ...	8/10½		30	25	6 15 3	9/-	8/8¼	10/1½	7/-
591,000	5/-	Wolverhampton Metal	22/3	+4½d.	27½	27½	6 3 6	22/4½	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	5/3	+3d.	20	20	9 10 6	5/4½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/-		6	6	9 4 6	—	—	13/-	11/3
150,000	1/-	Zinc Alloy Rust Proof	2/10½		27	40D	9 8 0	3/-	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% Capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced.


THIS

For straightening Tube...

Capacity of Machine shown Tubes $\frac{1}{4}$" to $1\frac{1}{2}$" diameter



at 560 ft PER MINUTE!

MADE IN ALL SIZES

On all classes of steel and non-ferrous tubes, these Bronx Type 6.CR. machines (all rolls driven) are unequalled for the highest straightening speeds giving perfect straightness with perfect surface finish. Illustrated is Type 6.CR 4—other machines in the series are capable of dealing with tubes from $\frac{1}{16}$" to 12" dia. Illustrated literature on request.

Telephone: LYE 2307 & 2308

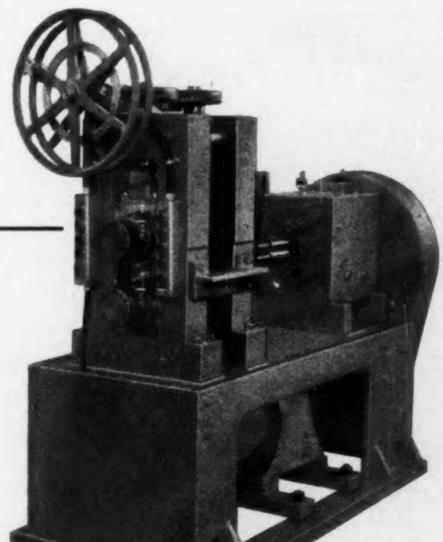
BRONX ENGINEERING CO. LTD., LYE, WORCS.

BRONX

MULTI - CROSS ROLL

TUBE STRAIGHTENING MACHINE

PRECISION ROLLING MILLS...



For rolling ferrous and non-ferrous metals in sheet, strip, wire, or rod. Two-high and four-high. Pinion or square gear drive. Standard line work-rolls from $1\frac{1}{4}$" to 20". Complete line of accessories. Special mills designed and built for unusual applications. Write for catalogue.

Built under licence by MARSHALL RICHARDS from the designs of Fenn Manufacturing Co., Connecticut, U.S.A.

MARSHALL RICHARDS

MACHINE COMPANY LIMITED

CROOK · COUNTY DURHAM · ENGLAND

TELEPHONE: CROOK 272 TELEGRAMS: MARICH CROOK

- **Precision Rolling Mills**
- **Swaging Machines**
- **Wire Shaping Mills**
- **Turks Heads**
- **Wire and Tube Drawing Machines**

F.15

Rates: Advertisements set in run-on style 4d. per word, minimum 4/–. Semi-displayed announcements are charged at 22/6 per inch depth. Box Numbers: add 5 words, plus 1/– for registration and forwarding replies. "Copy" accepted at London Office up to 1st post on each Friday for the following Friday's issue.

METAL INDUSTRY
CLASSIFIED ADVERTISEMENTS

Trade Discounts: Details upon application to "Metal Industry," Dorset House, Stamford Street, London, S.E.1. Remittances payable to Iliffe & Sons Ltd. The proprietors retain the right to refuse or withdraw "copy" at their discretion and accept no responsibility for matters arising from clerical or printers' errors.

APPOINTMENTS VACANT

YOUNG man with commercial experience required by well-established firm. Technical background preferred. Good prospects. Box 1792, c/o Metal Industry. [7696

E. AUSTIN & SONS (LONDON) LTD. require, at their Hertfordshire works, Metallurgist Chemist competent in analysis of copper-base alloys. Knowledge manufacture of these alloys essential. Details of experience, etc., to Managing Director, Atlas Wharf, London, E.9. [7688

APPOINTMENTS WANTED

METALLURGIST with established contacts in printing trade, East Anglia, Home Counties, Southern England, seeks representation with leading metal manufacturers. Box 1836, c/o Metal Industry. [7698

QUALIFIED Metallurgical Engineer (Hons. Degree) wishes to act in consulting capacity to Metallurgical Manufacturers. Prime interest, furnace design (electric, gas- and oil-fired, vacuum or controlled atmosphere) and problems relating to smoke abatement and dust collection. Box 1837, c/o Metal Industry. [7699

CAPACITY AVAILABLE

ALUMINIUM FOUNDRIES.
Gravity Dies Designed, Manufactured and Proved. Capacity Immediate.
R. E. ORMEROD LTD.,
EDNALL LANE, BROMSGROVE, WORCS. [7695

SHEET Metal Work, Metal Spinning, Deep Drawn Pressings, Stamping Press capacity 200 tons. Max. draw 15". Enquiries or specifications to Wades (Halifax) Ltd., Arden Works, Fenton Road, Halifax. [0019

KELLERING and Cam Profiling Capacity up to 8 ft.×6 ft., or 6 ft. diameter. ARMYTAGE BROS. (KNOTTINGLEY) Ltd., The Foundry, Knottingley, Yorkshire. Tel. Knottingley 2743/4. [0001

HEAT TREATMENTS

HEAT Treatment. A.I.D. Approved, all wrought and cast Light Alloys. Large sizes a speciality. Electro Heat Treatments Ltd., Bull Lane, West Bromwich. Phone Wes 0756. [0005

PLANT FOR SALE

160 TON High-speed Friction Screw Press by Hordern, Mason & Edwards. Steel Plate Frame. 10 h.p. motor drive.
1,000 TON Eumuco Knuckle Joint Coining and Sizing Press; 2" stroke, 31" between sides. As new.
REED BROTHERS (ENGINEERING) LTD., Replant Works, Woolwich Industrial Estate, London, S.E.18. Telephone: Woolwich 7611-6. [7701

ROLLING Mill Unit, comprising 2 Hot and 1 Cold 2-High Mills by Taylor and Farley, 21"×39", with 300 h.p. drive through power plant; double helical, double reduction gear box. First class condition. Approximately 250 tons.
24"×60" 2-High Flat Sheet Rolling Mill by Krupp, with pinion stand.
REED BROTHERS (ENGINEERING) LTD., Replant Works, Woolwich Industrial Estate, London, S.E.18. Telephone: Woolwich 7611-6. [7700

SCRAP METAL (SALE & WANTED)

B. J. PERRY & CO. LTD.
Exchange Buildings, Birmingham, 2, for Phosphor Bronze Swarf and Scrap and all Non-Ferrous Metals.
Tel.: Midland 5986-7. [0013

NICKEL and High Nickel Content Scrap wanted. "Nimonics," "Inconel," "Monel," etc. Offer for best prices to Nicholson & Rhodes Ltd., Princess St., Sheffield, 4. Phone 27491. [0011

FOR Sale, approx. 5 tons per month P.V.C. and Polythene Insulated Scrap Copper Wire and Strand. Offers to Box 1809, c/o Metal Industry. [7697

MATERIALS LABORATORY

A Technical Assistant is required at our Feltham premises with experience in the analytical control of plating solutions and a good knowledge of electro-deposition techniques. The work will include development of new processes.

An academic qualification would be helpful but consideration will also be given to unqualified applicants with good experience.

Please write in the first instance to the Personnel Manager:

SPERRY GYROSCOPE CO. LTD.,
Victoria Road, Feltham, Middx.

TIME RECORDERS

FACTORY Time Recorders. Rental Service. Phone Hop. 2239. Time Recorder Supply and Maintenance Co. Ltd., 157-159 Borough High Street, S.E.1. [0014

BOOKS

METALLURGICAL Progress, 2 & 3. One of the most time-consuming tasks for the more advanced metallurgical student and research worker is "searching the literature." In these critical reviews, members of the staff of The Royal Technical College, Glasgow, not only review the existing work to date, but also discuss its relative value, so making their survey infinitely more valuable. As in the second series of critical reviews, the third volume presents a reasoned survey of the current state of research knowledge on various aspects of metallurgy. Seven articles by leading authorities present the information in concise, easily readable form. 6s. post free. Series II, 4s. 6d. post free. Obtainable from leading booksellers, or direct from Iliffe and Sons Limited, Dorset House, Stamford Street, London, S.E.1.

RESISTANCE Welding in Mass Production. By A. J. Hipperson, B.Sc.(Eng.), A.M.Inst.W., and T. Watson, M.Inst.W. The ground covered by this book ranges from the first principles of each process to its scientific application in mass production. Particular reference is made to design and production requirements. 21s. net from all booksellers, 22s. 1d. by post from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

OXYGEN Cutting: A Comprehensive Study of Modern Practice in Manual and Machine Cutting. By E. Seymour Semper, M.I.Mech.E., M.Inst.W. Written to assist engineers concerned with cutting and shaping material, this book describes many of the machines designed for various applications of oxygen cutting to template with multiple heads and also the actual methods of operation. Price 10s. 6d. net. By post 11s. 4d. From all booksellers or from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

HANDBOOK of Industrial Electroplating. Second Edition. By E. A. Ollard, A.R.C.S., F.R.I.C., F.I.M., and E. B. Smith. Facts, figures and formulae for all who design, erect, maintain or operate electrodeposition plant, and for laboratory workers who deal with plating solutions. Includes sections on water and drainage, purification of solutions, safety precautions and ventilation in plating shops, and the special problems of costing in such shops. 35s. net from all booksellers. By post 36s. 5d. from Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

METALS and Alloys. Fifth Edition. This book contains approximately 4,600 compositions of non-ferrous alloy. It is mainly a list of alloys having definite names, including proprietary alloys, and is indispensable to users of non-ferrous metals and alloys in any industry. 15s. net from all booksellers. By post 16s. from Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

PRODUCTION Engineering: Practical Methods of Production Planning and Control. By J. S. Murphy, A.I.I.A. This practical book deals with factory organization, each separate item or function being discussed in the order in which it arises in practice. The book provides experienced production engineers with an opportunity to compare different methods. Price 12s. 6d. net. By post 13s. 5d. From all booksellers, or from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

MATERIAL Handling in Works Stores. 2nd Edition. By L. J. Hoefkens. Shows how the use of fork-lift trucks and pallets in industrial stores can increase production, utilize floor space more effectively, help control of movement and reduce costs. Includes a description of a system actually operated in a modern factory. 18s. 0d. net from all booksellers. By post 19s. 0d. from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

GAS Welding and Cutting: A Practical Guide to the Best Techniques. By C. G. Bainbridge, M.I.Mech.E., M.Inst.W. A comprehensive textbook providing practical information on almost the whole range of available gas welding and cutting equipment, methods and processes. Invaluable to the practical welder as well as to those responsible for gas welding and cutting operations involved in the fabrication and repair of industrial equipment. Price 15s. net. By post 16s. 0d. From all booksellers or from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

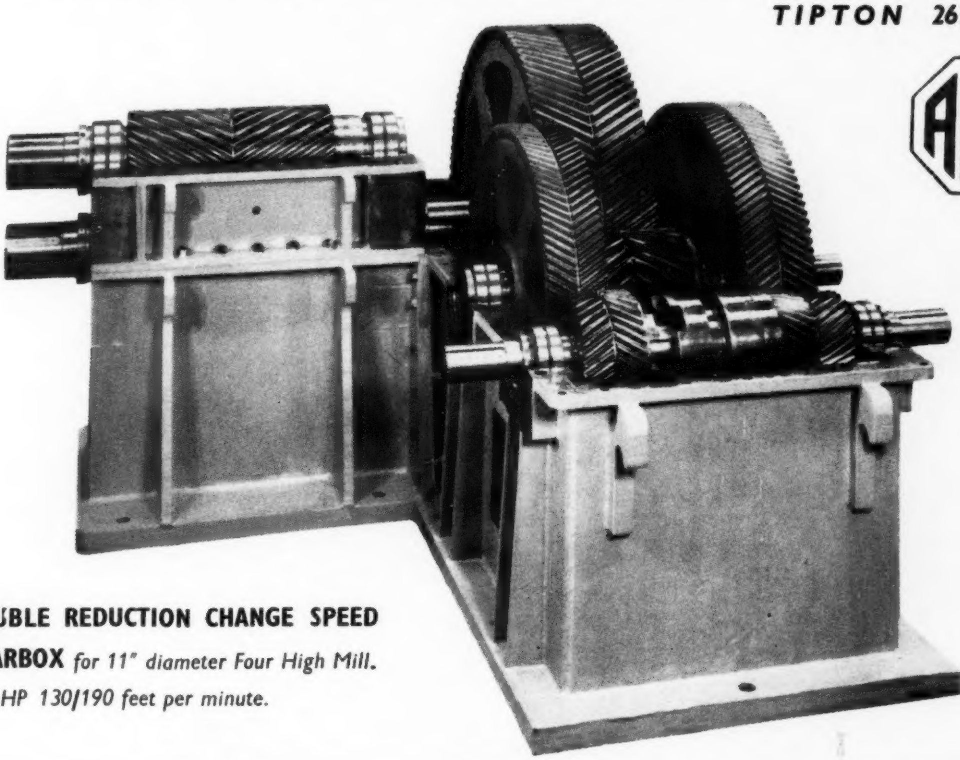
INDEX TO ADVERTISEMENTS

Printed in Great Britain by James Cond Ltd., Charlotte Street, Birmingham, 3. Published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

AUXILIARY ROLLING MACHINERY LTD.

TIPTON 2617/18/19

ARM



DOUBLE REDUCTION CHANGE SPEED GEARBOX *for 11" diameter Four High Mill.*
400 HP 130/190 feet per minute.

METALLURGICAL POLISHING & LAPPING MACHINES

SELF-CONTAINED WITH ELECTRIC MOTORS.

DISCS AND CLOTHS EASILY INTERCHANGED.

A BOON AND A TIME-SAVER TO THE METALLURGIST.

SINGLE & TWIN TABLE MACHINES AVAILABLE FOR EARLY DELIVERY

FULL DETAILS ON REQUEST TO MAKERS:-

E. W. JACKSON & SON LTD.
CHESWOLD WORKS
DONCASTER

Copper, Brass and Aluminium in Sheets, Tubes, Rods and Wire

DELIVERIES FROM STOCK

T. W. YOUNG LTD.
105 GOSWELL ROAD, E.C.1

Phone: Clerkenwell 2241/2 Grams: Wuzog, Barb.